

CLASS 75, SPECIALIZED METALLURGICAL PROCESSES, COMPOSITIONS FOR USE THEREIN, CONSOLIDATED METAL POWDER COMPOSITIONS, AND LOOSE METAL PARTICULATE MIXTURES

SECTION I - CLASS DEFINITION

This is the generic class for specialized metallurgical processes for producing or recovering metals from metal compounds, ores, or scrap metal and for refining liquid metal and for compositions used in these specialized metallurgical processes, consolidated metal powder compositions, and loose metal particulate mixtures.

Included in this class are patents drawn to:

(A) Processes for the production of solid, particulate free metal directly from liquid metal.

(B) Processes for the production or purification of free metal powder or the production or purification of alloys in powder form.

(C) Processes for the production or refining of free metal or alloys that use the electrothermal effects of electricity or electromagnetic wave energy or that use magnetism or electrostatics.

(D) Processes for the production of free metal by smelting, roasting, or furnace methods (a.k.a., pyrometallurgy) or by using a nonmetallic material which is liquid under standard conditions (a.k.a., hydrometallurgy).

(E) Processes for the treatment of liquid metal or melting metal.

(F) Processes for consolidating metalliferous charges or treating agents that are used in other processes of this class by agglomerating, compacting, indurating, or sintering.

(G) Compositions, not elsewhere provided for, disclosed as useful in metallurgical processes (e.g., reactive furnace linings, charges or solid treating compositions for producing free metal or alloys from metalliferous materials, gaseous or liquid compositions used in the production of free metal or alloys or used in the treatment of liquid metal) and processes of manufacturing compositions useful in metallurgical processes.

(H) Consolidated metal powder compositions having a continuous free metal phase, such as those produced by a process of the class of Powder Metallurgy Processes.

See Lines With Other Classes and Within This Class, 1., below.

(I) Loose metal particulate mixtures.

SECTION II - LINES WITH OTHER CLASSES AND WITHIN THIS CLASS

A. LIST OF CLASSES OF CHEMICAL COMPOUNDS AND COMPOSITIONS USED IN METALLURGICAL PROCESSES

148, Metal Treatment.

149, Explosive and Thermic Compositions or Charges.

252, Compositions.

423, Chemistry of Inorganic Compounds.

507, Earth Boring, Well Treating, and Oil Field Chemistry.

508, Solid Anti-Friction Devices, Materials Therefor, Lubricant or Separant Compositions for Moving Solid Surfaces, and Miscellaneous Mineral Oil Compositions.

B. LIST OF CLASSES OF FREE METAL PRODUCTS

148, Metal Treatment.

420, Alloys or Metallic Compositions.

428, Stock Material or Miscellaneous Articles.

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making.

C. LIST OF PROCESS CLASSES

65, Glass Manufacturing.

148, Metal Treatment.

164, Metal Founding.

204, Chemistry: Electrical and Wave Energy.

209, Classifying, Separating, and Assorting Solids.

241, Solid Material Comminution or Disintegration.

264, Plastic and Nonmetallic Article Shaping or Treating: Processes.

266, Metallurgical Apparatus.

419, Powder Metallurgy Processes.

420, Alloys or Metallic Compositions.

423, Chemistry of Inorganic Compounds.

502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making.

505, Superconductor Technology: Apparatus, Material, Process.

588, Hazardous or Toxic Waste Destruction or Containment.

D. ORDER OF SUPERIORITY AMONG VARIOUS METAL, ALLOY, AND METAL STOCK AREAS AND METHODS OF MANUFACTURE INVOLVING THEM.

The order of superiority among various metal, alloy, and metal stock areas and methods of manufacture involving them is as follows:

1. Class 419, Powder Metallurgy Processes.
2. Class 148, Metal Treatment, subclasses 22+, compositions for treatment of solid metal.
3. Class 75, Specialized Metallurgical Processes, Compositions for Use therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 300, 301, and 303+, gaseous, liquid, or solid treating compositions for liquid metal or charges, and subclass 302, welding rod defined by composition.
4. Class 75, Specialized Metallurgical Processes, Compositions for Use therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 228+, consolidated metal powder compositions and subclasses 255+, loose metal particulate mixtures.
5. Class 420, Alloys or Metallic Compositions, claimed as products.
6. Class 148, Metal Treatment, subclasses 95-122, 194-287, and 500-714, in class schedule order, providing for

certain processes of treating solid or semi-solid metal by modifying or maintaining internal physical structure (i.e., microstructure) or chemical properties of metal, processes of reactive coating of metal or processes of chemical-heat removing (e.g., flame-cutting etc.) or burning of metal. However, if metal casting, fusion bonding, machining, or working is involved, there is a requirement of significant heat treatment as described in the Class 148 definition, Lines With Other Classes, "Metal Casting, Metal Fusion Bonding, Machining, or Working Classes".

7. Class 148, Metal Treatment, subclasses 33+, barrier layer stock material and subclasses 400+, stock.

8. Class 75, Specialized Metallurgical Processes, Compositions for Use therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 331+, processes of making solid particulate alloys directly from liquid metal and subclasses 343+, processes of producing or purifying alloys in powder form.

9. Class 75, Specialized Metallurgical Processes, Compositions for Use therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 10.1+ and 10.67, processes of making alloys by electrothermic, electromagnetic, or electrostatic processes.

10. Class 420, Alloys or Metallic Compositions, processes of manufacture.

11. Class 75, Specialized Metallurgical Processes, Compositions for Use therein, Consolidated Metal Powder Compositions, and Loose Metal Particulate Mixtures, subclasses 330+, processes of making metal and processes or treating liquid metals and liquid alloys and consolidating metalliferous material.

12. Class 204, Chemistry: Electrical and Wave Energy, processes.

13. Class 164, Metal Founding, subclasses 1+, processes.

14. Class 266, Metallurgical Apparatus, subclasses 44+, processes of operating metallurgical apparatus.

15. Class 216, Etching a Substrate: Processes.

This list is not complete and may be added to as the proper relationship of other areas is determined.

The rules for determining Class placement of the Original Reference (OR) for claimed chemical compositions are set forth in the Class Definition of Class 252 in the section **LINES WITH OTHER CLASSES AND WITHIN THIS CLASS**, subsection **COMPOSITION CLASS SUPERIORITY**, which includes a hierarchical **ORDER OF SUPERIORITY FOR COMPOSITION CLASSES**.

SECTION III - REFERENCES TO OTHER CLASSES

SEE OR SEARCH CLASS:

- 65, Glass Manufacturing, subclasses 19+ for processes of treating (e.g., quenching, etc.), recovering, or manufacturing products from slag where no making of elemental metal is claimed, and subclass 141 for apparatus for treating slag with a liquid. Class 65 will take processes where the slag is identified as being obtained from a metal manufacturing process (e.g., blast furnace slag, etc.), as long as no positive step of making metal is claimed. (Process class).
- 148, Metal Treatment, appropriate subclasses for certain processes of treating solid or semi-solid metal by modifying or maintaining the internal physical structure (i.e., microstructure) or chemical properties of metal, processes of reactive coating of metal or processes of chemical-heat removing (e.g., flame-cutting etc.) or burning of metal. (Process class).
- 164, Metal Founding, appropriate subclasses, particularly subclasses 55.1+, for an alloying or refining step when performed during casting which includes treating while teeming or while in the mold. Class 75 provides for a process of refining combined with a Class 164 process (significant or nominal). The refining for Class 75 is done outside of a mold. (Process class).
- 148, Metal Treatment, subclasses 22+ for compositions employed in the treatment of solid metal (e.g., masking compositions, welding compositions, soldering fluxes, compositions for treating heated solid metal, etc.). (Class of chemical compounds and compositions used in metallurgical processes).
- 148, Metal Treatment, for elemental metal or alloys which (a) are the product of a Class 148 process (e.g., heat treated, age hardened); (b) are

claimed in terms of specific magnetic properties or as having particular internal structure which affects the magnetic properties; (c) are amorphous; (d) possess the property of shape memory; (e) are the product of a significant Class 164, Metal Founding, step (e.g., chill cast, directionally solidified), or (f) are the product of the dispersion of particulate matter in molten metal which particulate matter retains its identity in the final product (e.g., dispersion strengthened etc.). (Class of free metal products).

- 149, Explosive and Thermic Compositions or Charges, for exothermic compositions for treating metalliferous materials. See subclasses 5+, 20+, 30+, or 37+ for compositions which (1) contain at least one free metal or metalloid and at least one Oxygen (O) supplying material and (2) are capable of reacting to yield heat and reaction by-products. The line between Class 149 and Class 75 is difficult due to the similarity of ingredients in the compositions. If there is a positive recitation of exothermic utility, the original goes to Class 149 even if the composition is used in a Class 75 process. If the composition is used in a Class 75 process and there is no positive recitation of exothermic utility, it goes to Class 75 as an original. Patents having claims to both a Class 75 process and a Class 149 composition go to Class 75 as original and are crossed to Class 149. (Class of chemical compounds and compositions used in metallurgical processes).
- 204, Chemistry: Electrical and Wave Energy, appropriate subclasses for the preparation of metals, alloys, and products of utility only as intermediary products in a metallurgical process by electrical or wave energy methods including chemical reactions which are caused by more than the mere thermal effects of the electrical or wave energy. Lacking positive indication of more than a thermal effect, processes producing metals, treating metals, producing alloys or treating alloys go to Class 75. Branching processes wherein one branch comprises a process falling within the definition of Class 204 and wherein at least one branch comprises a process falling within the definition of Class 75 are classified in Class 75. Combinations of metallurgical process steps falling within the definition of Class 75 and electrical or wave energy process steps falling under the definition of Class 204, are classified in Class 204 when the metallurgical process steps are

- preparatory to the electrical or wave energy process steps and are classified in Class 75 when the electrical or wave energy process steps are preparatory to the metallurgical process steps. The foregoing applies even though such preparatory steps result in a desired by-product. (Process class).
- 209, Classifying, Separating, and Assorting Solids, for concentration processes which involve the separation of ore or metalliferous materials by nonchemical means (e.g., flotation, screening, amalgamation, etc.). Preparatory chemical processes for producing an intermediate for amalgamation, preparatory chemical processes followed by amalgamation, and chemical or physiochemical processes of breaking the amalgam to liberate the desired free metal will be found in Class 75, subclasses 388+. A combination of classifying, separating, or assorting metalliferous material that is to be used in a Class 75 process with consolidation will be found in Class 75. (Process class).
- 241, Solid Material Comminution or Disintegration, appropriate subclasses, for processes of comminuting or disintegrating solid metal, ore, or metalliferous material for the purpose of reducing their particle size and operations perfecting the same which do not involve a chemical treatment. A combination of comminution or disintegration with a step provided for in Class 75 will be found in Class 75. (Process class).
- 252, Compositions, for physical separation agents, barrier layer device compositions, magnetic compositions having a nonmetal matrix, etching or brightening compositions, descaling agents, detergents, getters, electrically conductive compositions, having a nonmetal matrix, radioactive compositions, chemical agents, solids with solution or dispersion aids, solvents, gaseous compositions, and preservative agents. Gaseous compositions and liquid compositions used in metallurgical processes will be found in Class 75, subclass 300. Solid treating compositions for molten metal or charges will be found in Class 75, subclasses 303+. (Class of chemical compounds and compositions used in metallurgical processes).
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 5+ for processes of forming solid particulate material directly from molten or liquid mass wherein a material other than metal is comminuted (see Class 75, subclass 331 for an amplification of the line), subclass 15 for spheroidizing or rounding of solid, nonmetallic particles (see Class 75 subclass 342 for an amplification of the line), and appropriate subclasses, particularly 109+, for uniting of bulk assembly particulate materials and for methods of compacting and briquetting nonmetallic particles intended for uses other than Class 75 or Class 420 refining or alloying. (Process class).
- 266, Metallurgical Apparatus, subclasses 44+, for processes of operating metallurgical apparatus which are solely directed to those steps of operating such an apparatus which do not effect a chemical or physical change in the work being treated. (Process class).
- 419, Powder Metallurgy Processes, appropriate subclasses, for processes of producing metals, alloys, or metal containing compositions in a solid or compact state from powdered or particulate material with or without heating. (Process class).
- 420, Alloys or Metallic Compositions, for processes of making alloys or metallic compositions. However, processes of making solid particulate alloys or metallic compositions directly from liquid metal will be found in Class 75, subclasses 331+ and processes of producing alloys or metallic compositions in powder form will be found in Class 75, subclasses 343+. In the instances in which the above mentioned processes are claimed and a process of making an alloy is claimed in generalized terms the patent will go as an original to Class 75 and a cross reference will be placed in Class 420. Processes of making an alloy by electrothermic, electromagnetic, or electrostatic steps will be found in Class 75, subclasses 10.1+ or subclass 10.67. In the instances in which the electrothermic, electromagnetic, or electrostatic steps are claimed and a process of making an alloy is claimed in generalized terms the patent will go as an original to Class 75 and a cross-reference will be placed in Class 420. In the instances in which the electrothermic, electromagnetic, or electrostatic steps are claimed and an alloy or metallic composition is claimed as a product, the patent will go as an original to Class 420 and a cross reference will be placed in Class 75. The line between Class 75 and Class 420 is necessarily a difficult one since the metals produced by the processes of Class 75 are often impure and the Class 420 alloys are sometimes made from ores. Therefore, the following lines will be observed. A process of making an alloy of desired composition for an end use will be

- classified in Class 420 even if made by reducing compounds or ore. A method of reduction or smelting to yield metal without intent to obtain a particular alloy or metallic composition will be classified in Class 75 even if it is recognized that the product is impure. Furthermore, methods of melting, refining, or removing a component from an existing alloy (e.g., purifying, etc.) will be found in Class 75. Melting of two or more metals or alloys together to produce an alloy will be found in Class 420. In the production of a ferroalloy, if the percentages of metals are specified the original will go to Class 420. (Process class).
- 420, Alloys or Metallic Compositions, for alloys or metallic compositions. An alloy or metallic composition made by consolidating base metal particles or a mixture of metal and nonmetal particles is proper for Class 75, subclasses 303+ or subclasses 228+ unless (a) all the components are melted or dissolved or (b) a part of the components is melted and the mass is treated as a fluent liquid (e.g., stirring, pouring, etc.) in which instances the product is proper for Class 420. Cases of doubt will be resolved in favor of placement in Class 75, subclasses 303+ or subclasses 228+. Class 75, subclasses 303+ or subclasses 255+ provide for compositions containing loose metal particles not elsewhere provided for. Class 420 provides for a free metal or a single alloy or metallic composition in particulate form. However, a blend of free metal particles or alloy or metallic composition particles with other particles whether another free metal, another alloy or metallic composition, or a nonmetal is proper for Class 75, subclasses 303+ or subclasses 255+. Class 420 also provides for patents claiming an article by name only without any positive structural limitation and reciting the metal or alloy or metallic composition of which the article is made. (Class of free metal products).
- 423, Chemistry of Inorganic Compounds, for inorganic compounds and nonmetallic elements, including metal compounds useful in metallurgical processes of obtaining free metals. Solid treating compositions for molten metal or charges for producing metal or treating molten metal, including compositions for or from consolidating, will be found in Class 75. (Class of chemical compounds and compositions used in metallurgical processes).
- 423, Chemistry of Inorganic Compounds, appropriate subclasses, for processes for chemically modifying metalliferous material (e.g., ore, scrap, etc.) to form products which comprise inorganic compounds even if intended for subsequent reduction to free metals. Processes recovering metal values go to Class 423 unless it can be determined conclusively that free metal (i.e., zero valent) is the metal value obtained, in which case the patent is placed as an original in Class 75. A smelting process is assumed to produce a free metal unless otherwise stated. Class 423, subclasses 1+ provide for processes of beneficiating a metalliferous ore where no free metal is obtained and the product is not consolidated. Beneficiation processes are classified in the first subclass under subclass 1 providing for the metal value recovered. Processes which simply remove an impurity from an ore without identifying any specific metal present (e.g., roasting, desulfurizing, dephosphorizing, or dearsenizing ore, etc.) are placed in subclass 1. Class 75, subclasses 746+ provide for consolidating metalliferous material (e.g., ore, tailings, flue dust, fluxes, etc.) by agglomerating, compacting or heat treating; preparatory process therefore; or treating consolidated material therefrom even though the production of a free metal is not claimed. Processes resulting in the production or separation of undesired metal (e.g., impurities, etc.) during the manufacture of Class 423 compounds are classified in Class 423. However, if the metal removed is recovered as a desired product, the patent is classified in Class 75. Recovery of the metal is assumed to be a process to produce a desired product for an end use unless otherwise stated. Patents including claims classifiable in Class 423 and equally comprehensive claims classifiable in Class 75 are classified in Class 75 and cross-referenced to Class 423. (Process class).
- 428, Stock Material or Miscellaneous Articles, for material or articles having some structure. In general, when claims mention the article by name only and define it in terms of composition, the original goes to the composition class. (Class of free metal products).
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for compositions that are used as catalysts, solid sorbents, and their supports even if they are made of metal or metal compounds. (Class of free metal products).

- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for processes of producing or rehabilitating metals or metalliferous products intended for use as a catalyst, sorbent, or support therefor. (Process class).
- 505, Superconductor Technology: Apparatus, Material, Process, subclasses 300+, for metallurgical operation similar to Class 75 operations that involve material superconducting above 30 degrees Kelvin. (Process class).
- 507, Earth Boring, Well Treating, and Oil Field Chemistry, for earth boring and well treating compositions. (Class of chemical compounds and compositions used in metallurgical processes).
- 508, Solid Anti-Friction Devices, Materials Therefor, Lubricant or Separant Compositions for Moving Solid Surfaces, and Miscellaneous Mineral oil Compositions, for lubricant compositions. (Class of chemical compounds and compositions used in metallurgical processes).
- 588, Hazardous or Toxic Waste Destruction or Containment, appropriate subclasses for the use of metals (molten or otherwise) in the destruction or containment of hazardous or toxic waste. (Process class).
- GERMANIUM (Ge); Ekatantalum = PROTACTINIUM (Pa); Erythronium = VANADIUM (V)
- Ferrum = IRON (Fe); Florentium = PROMETHIUM (Pm)
- Glucinum = BERYLLIUM (Be); Hydrargyrum = MERCURY (Hg)
- Illinium = PROMETHIUM (Pm); Kalium = POTASSIUM (K)
- Lutecium = LUTETIUM (Lu); Masurium = TECHNETIUM (Tc)
- Natrium = SODIUM (Na); Neoytterbium = YTTERBIUM (Yb)
- Plumbum = LEAD (Pb)
- Stannum = TIN (Sn); Stibnium = ANTIMONY (Sb)
- Virginium = FRANCIUM (Fr); Wolfram = TUNGSTEN (W)

ACTINIDE*

A metal of the group Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), and Lawrencium (Lr).

ALKALI METAL*

A metal of the group Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), and Francium (Fr).

ALKALINE EARTH METAL*

A metal of the group Calcium (Ca), Strontium (Sr), Barium (Ba), and Radium (Ra).

ALLOY

A union, possessing metallic properties of two or more metallic elements or of nonmetallic element (s) and metallic elements(s) which are not pure compounds and which are miscible with each other, which at least to a certain extent when molten forms a more or less homogeneous liquid having a metallic matrix and which does not separate into distinct layers when solid. Such combi-

SECTION IV - GLOSSARY

(Asterisked * terms are employed in section C, Chemistry and Metallurgy of the International Patent Classification (IPC) and have the same meaning herein.)

Synonyms of names of metal elements used in this class (mostly obsolete) are listed below. The names used in this class are in capital letters, the synonyms in lower case.

Aldebaranium = YTTERBIUM (Yb); Argentum = SILVER (Ag); Aurum = GOLD (Au); Ausonium = NEPTUNIUM (Np); Austrium = GALLIUM (Ga)

Cassiopeium = LUTETIUM (Lu); Celtium = LUTETIUM (Lu); Columbium = NIOBIUM (Nb)

Demonium = DYSPROSIUM (Dy); Didymium = NEODYMIUM (Nd) and PRASEODYMIUM (Pr); Dwimanganese = RHENIUM (Re)

Eka - aluminum = GALLIUM (Ga); Ekaboron = SCANDIUM (Sc); Ekacesium = FRANCIUM (Fr); Ekamanganese = TECHNETIUM (Tc); Ekasilicon =

nations when solidified from a melt may consist of mechanical mixtures, entectics, entectoids, solid solutions, or in part of chemical compounds one or more of which may exist at the same time. Intermetallic compounds are considered alloys for purposes of classification.

- (1) Note. The term “alloy” when used in the various definitions of Class 75 is considered to include a “metallic composition” (q.v.) of the type that is found in Class 420.

AMALGAMATION

The use of a liquid metal to collect, to alloy, or to adhere a desired free metal without melting the desired free metal with heat.

BASE

A metal which is present in an amount of over 50% by weight in an alloy.

BESSEMER CONVERTER

A device having passages in its bottom (i.e., tuyeres) through which a gas containing gaseous Oxygen (e.g., air, etc.) is passed upwardly through molten metal or molten metalliferous material (e.g., matte, etc.) to treat the metal or material.

BLAST FURNACE

A type of shaft furnace specifically designed to reduce metal compounds (e.g., ore, etc.) to elemental metal using a combustible solid reductant (e.g., coke, etc.). The furnace is designed to operate continuously for a long period of time, with solid reductant, metal compound, and any other desired solid additive (e.g., flux, etc.) being continuously or periodically added at the top of the furnace and the resulting molten metal and by-product slag being continuously or periodically tapped from the bottom of the furnace. A gas containing gaseous Oxygen (e.g., air, etc.) is preheated (usually by the exhaust gas) and is injected into the furnace through tuyeres above the molten metal and slag level.

CEMENTATION

A process of recovering a free metal from solution wherein a more electropositive free metal displaces a less electropositive metal from solution as a free metal while the more electropositive metal goes into solution in ionic form.

CONSOLIDATE

To form into a compact mass.

CRUCIBLE FURNACE

A furnace in which the material to be heated is placed in a refractory container, the container is covered with a lid, and the covered container is heated in a furnace. The material is heated solely by heat conducted through the walls of the crucible.

CUPOLA

A shaft furnace primarily designed to melt metal by use of a solid fuel charged with the metal. A gas containing gaseous Oxygen (e.g., air) is blown into the bottom of the furnace to burn the fuel and cause the metal to melt from the heat of combustion.

DISPLACEMENT REACTION FOR METALS

In the reaction $A + BC = AC + B$, the metal A, being more positive than the metal B, is oxidized. The displacement series or electromotive series for metals in decreasing order of their negative potentials is: (negative) Vanadium (V), Tungsten (W), Molybdenum (Mo), Gold (Au), Osmium (Os), Platinum (Pt), Iridium (Ir), Tantalum (Ta), Palladium (Pd), Ruthenium (Ru), Antimony (Sb), Bismuth (Bi), Arsenic (As), Mercury (Hg), Silver (Ag), Copper (Cu), Titanium (Ti), Tin (Sn), Lead (Pb), Germanium (Ge), Zirconium (Zr), Cerium (Ce), Nickel (Ni), Cobalt (Co), Thallium (Tl), Niobium (Nb), Cadmium (Cd), Iron (Fe), Chromium (Cr), Zinc (Zn), Manganese (Mn), Uranium (U), Gadolinium (Gd), Indium (In), Gallium (Ga), Aluminum (Al), Rare Earth Metals, Beryllium (Be), Scandium (Sc), Yttrium (Y), Magnesium (Mg), Lithium (Li), Calcium (Ca), Strontium (Sr), Barium (Ba), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs) (positive).

FLUIDIZED BED

A bed of solid particles with gas flowing upward through the particles with sufficient velocity to keep the particles suspended and in motion in the gas without blowing them bodily out of the top of the bed. The suspended particles act much like a fluid.

GASEOUS SUSPENSION

The suspension of solid in gas. This may be in a fluid-

ized bed (q.v.) or in any other system (such as a conduit) where solids are suspended in a gas.

HALOGEN*

An element of the group Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), and Astatine (At).

HEAVY METAL*

A metal other than a light metal (q.v.).

HYDROMETALLURGY

A somewhat inexact term for processes involving solution in water or other liquid in which metalliferous material or metal is treated to prepare free metal, to purify, or to refine free metal, or to prepare intermediate materials more suitable for use in preparing free metal (e.g., extracting, leaching, beneficiating, etc.).

IRON GROUP

An element of the group Iron (Fe), Cobalt (Co), and Nickel (Ni).

LANTHANIDE*

A metal of the group Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Promethium (Pm), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Th), Ytterbium (Yb), and Lutetium (Lu).

LIGHT METAL*

A metal of the group Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), Francium (Fr), Calcium (Ca), Strontium (Sr), Barium (Ba), Radium (Ra), Beryllium (Be), Magnesium (Mg), and Aluminum (Al).

METAL*

Element other than nonmetal (q.v.).

METALLIC COMPOSITION

A composition which contains a continuous phase of metal and no continuous phase of nonmetal.

MUFFLE FURNACE

A furnace in which the material to be heated is placed in an enclosed section (the muffle), which protects the material from the combustion products of the furnace. The material is heated by heat conducted through the walls of the muffle.

NOBLE GAS*

An element of the group Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (X), and Radon (Rn).

NOBLE METAL*

A metal of the group Ruthenium (Ru), Rhodium (Rd), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), and Gold (Au).

NONMETAL*

An element of the group Hydrogen (H), Boron (B), Carbon (C), Silicon (Si), Nitrogen (N), Phosphorus (P), Oxygen (O), Sulfur (S), Selenium (Se), Tellurium (Te), Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), Astatine (At), Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe), and Radon (Rd).

(1) Note. For subclasses 228+ Silicon is considered to be a metal.

PLATINUM GROUP*

An element of the group Osmium (Os), Iridium (Ir), Platinum (Pt), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd).

PRECIOUS METAL

Synonym for Noble Metal (q.v.).

PYROMETALLURGY

A somewhat inexact term for processes carried out at relatively high temperatures, usually in furnaces, in which metalliferous material or metal is treated to prepare free metal, to purify or to refine free metal, or to prepare intermediate materials more suitable for use in preparing free metal (e.g., smelting, bessemerizing, roasting of ores, etc.).

RADIOACTIVE ELEMENT

An element of the group Technetium (Tc), Promethium (Pm), Polonium (Po), Astatine (At), Radon (Rn), Fran-

cium (Fr), Radium (Ra), Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), Lawrencium (Lr), Unnilquadium (Unq), Unnipientium (Unp), and Unnilhexium (Unh).

RARE EARTH METAL*

An element of the group Scandium (Sc), Yttrium (Y), Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Promethium (Pm), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), and Lutetium (Lu).

REFRACTORY METAL*

A metal of the group Titanium (Ti), Zirconium (Zr), Hafnium (Hf), Vanadium (V), Niobium (Nb) or Columbium (Cb), Tantalum (Ta), Chromium (Cr), Molybdenum (Mo), and Tungsten (W).

REVERBERATORY FURNACE

An enclosed furnace in which the material to be heated is placed in the bottom of the furnace and gaseous fuel is burned over the top of the material or the flame or combustion products from burning solid fuel separately from the material to be heated are reflected by the top of the furnace and passed over the material. Types of reverberatory furnace are the Siemen-Martin furnace, the open hearth furnace, and the puddling furnace.

ROTARY KILN

An approximately cylindrical apparatus which rotates on its axis in operation. The axis is horizontal or inclined less than 45 degrees from horizontal. Usually, the axis is slightly inclined from horizontal. In operation the kiln rotates substantially continuously in one direction.

SCRAP

Discarded waste metal suitable for reprocessing.

SHAFT FURNACE

A vertical approximately cylindrical apparatus in which material to be treated is passed downwardly through the shaft while it is heated in any manner. In this class the

material treated in the furnace is usually either reduced to free metal or melted or both.

SYNONYMS

See the beginning of the Glossary section for a list of synonyms of names of metal elements used in this class (mostly obsolete).

TRANSITION METAL*

A metal of the group Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Yttrium (Y), Zirconium (Zr), Niobium (Nb) or Columbium (Cb), Molybdenum (Mo), Technetium (Tc), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Silver (Ag), Cadmium (Cd), Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Promethium (Pm), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), Lutetium (Lu), Hafnium (Hf), Tantalum (Ta), Tungsten (W), Rhenium (Re), Osmium (Os), Iridium (Ir), Platinum (Pt), Gold (Au), Mercury (Hg), Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), Lawrencium (Lr), Unnilquadium (Unq), Unnipientium (Unp), and Unnilhexium (Unh).

VERTICAL RETORT

A vertical, generally cylindrical, vessel closed at the bottom and heated externally so that the contents are heated only by heat conducted through the retort walls. Often a product is volatilized from the retort and collected in another container.

SUBCLASSES

10.1 **Electrothermic processes (e.g., microwave, induction, resistance, electric arc, plasma, etc.):**

This subclass is indented under subclass 330. Process for producing or treating free metal or alloys that involve production of thermal energy from electricity, electromagnetic, or wave energy at any stage in the process.

- (1) Note. The use of electrothermal energy may occur at any stage in the process. Thus, melting of slag, ore or metal in an

electric furnace and subsequent transfer to another converter and treating therein is to be considered an electrothermic process.

SEE OR SEARCH THIS CLASS, SUBCLASS:

10.67, for the use of electromagnetic energy for stirring or transporting without production of thermal energy therefrom.

SEE OR SEARCH CLASS:

204, Chemistry: Electrical and Wave Energy, for chemical processes using electrical and wave energy to produce or treat free metal by means other than production of heat.

(1) Note. Problems arise between Class 75 and Class 204 when an energy form is given without indication of the mechanism of its utilization. If the mechanism involves only conversion of the energy form to heat or if the utilization of the energy is preparatory to a Class 75 operation, the original goes to Class 75. When the mechanism is not clear from the specification and not preparatory to a Class 75 operation the following line is followed for purposes of classification. Placement goes to Class 75 if reactants (e.g., reducing agents, etc.) other than the starting material (e.g., ore, etc.) are present which would normally react in the presence of heat to produce the desired product (e.g., Iron, etc.). Otherwise, placement goes as original to Class 204. See References to Other Classes, of the Class 204 definition for an expansion of the class line between Class 75 and Class 204, including a superiority listing of classes providing for various metals, alloys, and metal stocks and methods of manufacturing them.

10.11 **With zone melting or fractional crystallization:**

This subclass is indented under subclass 10.1. Processes wherein solid metal is traversed by a melt zone causing migration of impurities within the metal resulting in purification of the metal (i.e., zone melting) or processes of refining molten metal or metal alloys by selective crystallization and separation of the crystalline phase from the melt to effect purification (i.e., fractional crystallization).

SEE OR SEARCH CLASS:

117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metal; e.g., by zone melt processing. References disclosing processes which form Class 117 defined single-crystal material and also form an amorphous material and/or a polycrystalline material should be placed according to the following guidelines: placement should be determined first by the most comprehensive claim; if that is not determinative placement should be determined as follows: (a) references having only generic claims should have the original placed in Class 117 with appropriate cross-reference, (b) references having all species claims placeable in one class should have the original placed in that class with appropriate cross-reference, or (c) references having equally comprehensive species claims should have the original placed in Class 117 with appropriate cross-reference.

10.12 **Controlling process through sensed condition:**

This subclass is indented under subclass 10.1. Processes in which include regulating the electrothermic process through a detected condition.

10.13 Electromagnetic wave energy (e.g., microwave, laser, etc.):

This subclass is indented under subclass 10.1. Processes in which thermal energy is produced by electromagnetic wave irradiation (e.g., microwave, laser, etc.).

10.14 Electrical induction:

This subclass is indented under subclass 10.1. Processes wherein an electric current is induced in the material being treated to provide thermal energy.

10.15 Producing or treating Iron (Fe) or Iron alloy:

This subclass is indented under subclass 10.14. Process wherein Iron (Fe) or an alloy containing Iron in any amount is produced or treated.

10.16 With induced magnetic stirring:

This subclass is indented under subclass 10.15. Process wherein the material is mixed using induced magnetic energy.

10.17 With gaseous treating agent:

This subclass is indented under subclass 10.15. Process which also involves the use of a gaseous material.

10.18 Producing or treating Aluminum (Al), Beryllium (Be), Cobalt (Co), Chromium (Cr), Magnesium (Mg), Nickel (Ni), Titanium (Ti), or alloy thereof:

This subclass is indented under subclass 10.14. Process wherein elemental Aluminum (Al), Beryllium (Be), Cobalt (Co), Chromium (Cr), Magnesium (Mg), Nickel (Ni), Titanium (Ti), or alloy thereof is produced or treated. The alloy produced or treated can contain the above mentioned metals in any amount.

10.19 Plasma:

This subclass is indented under subclass 10.1. Processes wherein a wholly or partially charged mixture of gaseous ions and electrons (i.e., plasma is the source of thermal energy).

10.2 Influenced by magnetic field:

This subclass is indented under subclass 10.19. Process wherein the plasma is influenced by a magnetic field.

10.21 Producing or treating Aluminum (Al) or Aluminum alloy:

This subclass is indented under subclass 10.19. Process wherein elemental Aluminum (Al) or an alloy containing Aluminum in any amount is produced or treated.

10.22 Producing or treating Iron (Fe) or Iron alloy:

This subclass is indented under subclass 10.19. Process wherein Iron (Fe) or an alloy containing Iron in any amount is produced or treated.

10.23 Consumable metal-containing electrode:

This subclass is indented under subclass 10.1. Processes wherein an electrode containing a metal, metal compound or alloy is used up or melted by electrothermic energy and the metal therefrom incorporated in a molten substrate.

(1) Note. A consumable "carbon electrode" having no metal, metal compound or alloy present is excluded from this subclass.

(2) Note. The consumable electrode may contain solid treating agent or flux.

SEE OR SEARCH CLASS:

164, Metal Founding, subclasses 48+ for electrothermic processes involving consumable electrodes that occur in the mold.

10.24 Electroslag remelting:

This subclass is indented under subclass 10.23. Process wherein the electrode is in electrical contact with a slag and the electrical current therebetween melts the electrode causing the molten metal therefrom to be refined by passing through the slag.

10.25 Producing or treating Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Titanium (Ti), or alloy thereof:

This subclass is indented under subclass 10.24. Process wherein elemental Chromium (Cr), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), Nickel (Ni), Titanium (Ti), or alloy thereof is produced or treated by electroslag remelting. The alloy produced or treated can

- contain the above mentioned metals in any amount.
- 10.26 Producing or treating Titanium (Ti) or Zirconium (Zr) or alloy thereof:**
This subclass is indented under subclass 10.23. Process wherein elemental Titanium (Ti) or Zirconium (Zr) or alloy thereof, is produced or treated using a consumable electrode. The alloy produced or treated can contain the above mentioned metals in any amount.
- 10.27 Carbothermic reduction of Aluminum (Al) compound:**
This subclass is indented under subclass 10.1. Processes wherein an Aluminum (Al) compound is reduced in the presence of a carbonaceous material, carbon or carbide.
- 10.28 With volatilization of metal halide:**
This subclass is indented under subclass 10.1. Process that involves the gasification or formation and gasification of a metal halide.
- 10.29 Distillation or volatilization of refined metal or compound thereof:**
This subclass is indented under subclass 10.1. Process wherein refined metal or metal compound is condensed or gasified.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
10.28, for volatilization of metal halides or subclass 10.27 for that carbothermic reduction of Aluminum (Al) compound involves volatilization of aluminum.
- 10.3 Producing Zinc (Zn):**
This subclass is indented under subclass 10.29. Process wherein the volatilized metal is Zinc (Zn).
- 10.31 From consolidated material (e.g., briquette, pellet, etc.):**
This subclass is indented under subclass 10.3. Process wherein the Zinc (Zn) containing material is charged or utilized in consolidated form (e.g., briquette, pellet, etc.).
- 10.32 With electric arc:**
This subclass is indented under subclass 10.3. Process wherein an electric arc is used.
- 10.33 Producing Magnesium (Mg):**
This subclass is indented under subclass 10.29. Process wherein the volatilized metal is Magnesium (Mg).
- 10.34 Rotating chamber:**
This subclass is indented under subclass 10.1. Process wherein a chamber or converter that rotates 360 degrees is used.
- 10.35 Reducing or smelting slag or dross as starting material:**
This subclass is indented under subclass 10.1. Process in which a slag or dross is the starting material that is reduced or smelted.
- 10.36 Exhaust or top gas reused or treated:**
This subclass is indented under subclass 10.1. Process wherein an exhaust or top gas from any process stage is reused or treated.
- 10.37 With production of electrical energy:**
This subclass is indented under subclass 10.36. Process wherein all or a portion of the exhaust or top gas is used to generate electrical energy.
- SEE OR SEARCH CLASS:
60, Power Plants, for residual processes of converting exhaust to mechanical energy and generation of electrical energy.
- 10.38 Producing or treating Iron (Fe) or Iron alloy:**
This subclass is indented under subclass 10.36. Process wherein Iron (Fe) or Iron containing alloy is produced or treated.
- 10.39 Adding gaseous treating agent:**
This subclass is indented under subclass 10.1. Process wherein a gaseous treating agent is injected into or onto, or through the charge or melt.
- 10.4 Gas contains gaseous Oxygen:**
This subclass is indented under subclass 10.39. Process wherein Oxygen gas or an Oxygen gas containing gaseous composition (e.g., air) is the treating agent.

10.41 Producing or treating Iron (Fe) or Iron alloy:

This subclass is indented under subclass 10.4. Process wherein Iron (Fe) or Iron containing alloy is produced.

10.42 With charge melting by electrothermal energy:

This subclass is indented under subclass 10.41. Process wherein the charge is melted by electrothermal energy (e.g., in an electric furnace, etc.).

10.43 Hydrogen or Water vapor:

This subclass is indented under subclass 10.39. Process wherein hydrogen or water vapor is the treating agent.

10.44 Carbon monoxide or Carbon dioxide:

This subclass is indented under subclass 10.39. Process wherein Carbon monoxide or Carbon dioxide is the treating agent.

10.45 Noble gas, Nitrogen, or inert gas not otherwise identified:

This subclass is indented under subclass 10.39. Process wherein Argon (Ar), Helium (He), Krypton (Kr), Neon (Ne), Radon (Rn), Xenon (Xe), Nitrogen (N), or an inert gas not otherwise identified is the treating agent.

10.46 Adding solid treating agent, slag, or flux:

This subclass is indented under subclass 10.1. Process wherein a solid treating agent, separately prepared slag, or flux is added to the charge or melt.

10.47 Magnesium (Mg) or compound thereof:

This subclass is indented under subclass 10.46. Process wherein Magnesium (Mg) or a Magnesium compound (e.g., Magnesite, etc.) is present in the treating agent, separately prepared slag, or flux.

10.48 Aluminum (Al) or compound thereof:

This subclass is indented under subclass 10.46. Process wherein Aluminum (Al); or an Aluminum compound (e.g., Alumina, etc.) is present in the treating agent, separately prepared slag, or flux.

10.49 Boron (B) or compound thereof:

This subclass is indented under subclass 10.46. Process wherein Boron (B) or Boron compound (e.g., borax, Boron carbide, etc.) is present in the treating agent, separately prepared slag, or flux.

10.5 Silicon (Si) or compound thereof:

This subclass is indented under subclass 10.46. Process wherein Silicon (Si) or a Silicon compound (e.g., Silica, etc.) is present in the treating agent, separately prepared slag, or flux.

SEE OR SEARCH CLASS:

423, Chemistry of Inorganic Compounds, subclasses 324+ for production of Silicon or a Silicon compound, per se. However, electrothermic processes for forming metal-silicon alloys are proper for Class 75, subclasses 10.1+.

10.51 Ferrosilicon alloy:

This subclass is indented under subclass 10.5. Process wherein a Ferrosilicon alloy is present in the treating agent, separately prepared slag, or flux.

10.52 Silicon carbide:

This subclass is indented under subclass 10.5. Process wherein Silicon carbide is present in the treating agent, separately prepared slag, or flux.

10.53 With lime present:

This subclass is indented under subclass 10.5. Process wherein Calcium oxide (i.e., lime) is present with the Silicon (Si) or Silicon compound.

10.54 Alkali metal, Alkaline earth metal, or compound thereof:

This subclass is indented under subclass 10.46. Process wherein an Alkali metal, Alkaline earth metal, or compound thereof is present in the treating agent, separately prepared slag, or flux.

10.55 Calcium fluoride (e.g., Fluorspar, Fluorite, etc.):

This subclass is indented under subclass 10.54. Process wherein Calcium fluoride (e.g., Fluorspar, Fluorite, etc.) is the Alkaline earth metal compound.

- 10.56 Calcium carbide:**
This subclass is indented under subclass 10.54. Process wherein a Calcium carbide is the Alkaline earth metal compound.
- 10.57 Calcium carbonate (e.g., limestone, etc.):**
This subclass is indented under subclass 10.54. Process wherein Calcium carbonate is the Alkaline earth metal compound.
- 10.58 Calcium oxide (e.g., lime, calx, etc.):**
This subclass is indented under subclass 10.54. Process wherein a Calcium oxide (e.g., lime, calx, etc.) is the Alkaline earth metal compound.
- 10.59 Carbon (C) containing material (e.g., Carbon, carbonaceous material, Carbide, etc.):**
This subclass is indented under subclass 10.46. Process wherein a Carbon (C) containing material (e.g., Carbon, carbonaceous material, Carbide, etc.) is present in the treating agent, separately prepared slag, or flux.
- 10.6 Producing or treating Iron (Fe) or Iron alloy:**
This subclass is indented under subclass 10.59. Process wherein Iron (Fe) or Iron containing alloy is produced or treated.
- 10.61 With electric arc:**
This subclass is indented under subclass 10.6. Process wherein an electric arc is used.
- 10.62 Reducing or smelting:**
This subclass is indented under subclass 10.1. Process wherein there is a reducing or smelting operation and which are not classifiable in the subclasses herein above provided.
- 10.63 Producing or treating Iron (Fe) or Iron alloy:**
This subclass is indented under subclass 10.62. Process wherein Iron (Fe) or Iron containing alloy is produced or treated.
- 10.64 Vacuum purifying or degassing:**
This subclass is indented under subclass 10.1. Process wherein reduced pressure is used to purify or degas the molten metal.
- 10.65 Melting or holding melt:**
This subclass is indented under subclass 10.1. Process wherein there is a melting step or a step of holding the material in a molten state.
- 10.66 Producing or treating Iron (Fe) or Iron alloy:**
This subclass is indented under subclass 10.65. Process wherein Iron (Fe) or Iron containing alloy is produced or treated.
- 10.67 Magnetic (e.g., electromagnetic, etc.) or electrostatic processes:**
This subclass is indented under subclass 330. Process wherein magnetic (e.g., electromagnetic etc.) or electrostatic energy is used for purposes other than production of heat (e.g., stirring transporting, etc.).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
10.1+, for electrothermic processes for the intentional production of heat.
- 228 Consolidated metal powder compositions:**
This subclass is indented under subclass 300. Composition comprising free-metal containing powder or particles which have been united to form a self-sustaining mass.
- (1) Note. "Powder" is defined as a mass of particles, that is, portions of matter so small that they are not ordinarily handled as individual units. According to Metals Handbook, 8th Edition, 1961, Volume 1, page 28, metallic powders then used in powder metallurgy had a particle size within the range of 0.1 to 1,000 microns in their largest dimension, as determined by screens or other suitable instruments. Powder particles generally are distinguished from filamentary particles in that their shape and length-to-diameter ratio are such that in the dry state the particles will not hold together as a coherent article without the application of pressure and or heat, that is, will not become entangled.
- (2) Note. This and the indented subclasses include compositions made without any melting or fusion of the particles, as well as those made by sintering, that is, a pro-

cess in which a portion of metal particle is alloyed, bonded, brazed, coalesced, partly fused or welded to a portion of an adjacent metal particle due to the application of heat, or heat and pressure. Reference: Everhart, J. L., et al., "Mechanical Properties of Metals and Alloys", Circular of the National Bureau of Standards, C 447, 1943, page 16.

- (3) Note. The composition may contain non-metal material, but for classification in this subclass, the claimed product must have a metallic matrix, that is, must have a continuous metal phase in which the nonmetallic material is dispersed as a discontinuous phase. In the absence of a more explicit description, such a situation may be assumed when (a) the composition contains more than 40% metal; (b) the composition is prepared by a process which would inherently unite the metal particles without uniting the non-metal component; or (c) the composition is described as nonmetal particles "cemented" with a metal.
- (4) Note. Where a patent contains a claim to a consolidated metal powder composition and, in addition, one or more claims to (a) a process for making the composition and/or (b) an ingredient or unconsolidated mixture for use in the process, the patent is classified in this or the indented subclasses (228+) and cross-referenced to the other subclass, even though such other subclass may precede this in the schedule of this class (75).
- (5) Note. Those patents are placed in this subclass (228) which claim all metal compositions wherein the base metal may be (a) either a transition or nontransition metal, or (b) a nontransition metal not provided for below, that is, the Alkali metals (i.e., Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs), and Francium (Fr)); the Alkaline earth metals (i.e., Calcium (Ca), Strontium (Sr), Barium (Ba), and Radium (Rd)); Gallium (Ga), Indium (In); Thallium (Tl); Silicon (Si), which is considered a metal in this and its indented subclasses; Germanium (Ge); Tin (Sn);

Lead (Pb); Arsenic (As); Antimony (Sb); and Bismuth (Bi).

- (6) Note. In this and the indented subclasses a "metal silicide" is considered to be an intermetallic compound or alloy.
- (7) Note. The order of superiority among various alloy, metallic composition and metal stock areas and methods of manufacture involving them is given in the class definition under Lines With Other Classes and Within This Class.

SEE OR SEARCH THIS CLASS, SUBCLASS:

251, for unconsolidated mixtures of metal powder.

SEE OR SEARCH CLASS:

- 102, Ammunition and Explosives, subclasses 283+ for a solid propellant form defined in such terms as "a generally perforated propellant mass," "a configured mass, i.e., sheet," with at least one dimension specified, or a porous mass in combination with an ancillary perforation extending there-through.
- 106, Compositions: Coating or Plastic, subclasses 403+, for pigments, fillers, and aggregates containing metal powder.
- 148, Metal Treatment, subclass 126.1 for processes involving heat treatment of metal powders, or nonconsolidated metal powder compositions.
- 149, Explosive and Thermic Compositions or Charges, especially subclasses 37+ for articulate metals in combination with an oxidant component.
- 174, Electricity: Conductors and Insulators, subclass 118 for a device of that class insulated with powdered or granular compositions, and subclass 137 for insulator devices, per se.
- 228, Metal Fusion Bonding, subclass 19 for an apparatus of that class with a means to compact applied flux.
- 252, Compositions, subclass 62.51 for magnetic compositions having a non-metal matrix; subclasses 181.1+ for "getter" compositions; and subclasses

- 500+ for electrically conductive compositions having a nonmetal matrix.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 109+, particularly subclasses 111, for processes directed to forming of articles by uniting of discrete, bulk assembled particles. See the search notes to Class 264 in Class 29, subclass 602, and see the definitions in Class 264 and pertinent subclasses as cited herein for the line between these classes.
- 285, Pipe Joints or Couplings, subclass 422 for such articles made of particular metal compositions.
- 338, Electrical Resistors, subclasses 223+ for a granular or powdered resistor element.
- 419, Powder Metallurgy Processes, subclasses 1+ for powder metallurgy processes which include use of heat.
- 420, Alloys or Metallic Compositions, appropriate subclasses for metallic compositions made by fusing (melting) the metals. A composition made by consolidating loose metal particles with heat and/or pressure is proper for subclass 228 unless either (a) all the components are melted or dissolved, or (b) a part of the components are melted and the mass is treated as a fluent liquid, e.g., by stirring, pouring, etc. Cases of doubt will be resolved in favor of placement in subclass 228.
- 423, Chemistry of Inorganic Compounds, subclasses 1+ for processes of treating mixtures such as alloys to obtain a metal compound therefrom.
- 425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 78 for apparatus for forming products by uniting associated particles of metallic elements, or alloys, or amalgams.
- 428, Stock Material or Miscellaneous Articles, subclasses 539.5, 545 and 546+ for material or articles of that class containing consolidated metal powder, subclass 570 for a composite metallic powder, and subclass 613 for porous, nonparticulate metallic stock material.
- 501, Compositions: Ceramic, appropriate subclasses for ceramic compositions having metal powder, but lacking a continuous metal matrix.
- 520, Synthetic Resins or Natural Rubbers, particularly Class 523, subclasses 1+ for a synthetic resin or natural rubber containing an ingredient which may be metallic.
- 229 Flake or fibrous constituent or fibrous grain structure:**
This subclass is indented under subclass 228. Composition which (1) contains a particle component which has a thickness which is diminutive in comparison with its length and width, or (2) has a component originally contained in the starting material or produced during the uniting of the particles or subsequent processing, which is characterized by a width and thickness which is diminutive compared to its length, e.g., fibrous, circular, needle-like, whiskerish, etc.
- SEE OR SEARCH CLASS:
191, Electricity: Transmission to Vehicles, subclasses 45 and 59.1 for collectors of that class.
428, Stock Material or Miscellaneous Articles, especially subclasses 292+, 549 and 567 for such material involving fibers.
- 230 With nonmetal constituent - Silicon (Si) considered a metal (e.g., cermet, etc.):**
This subclass is indented under subclass 228. Composition containing one of the following, in free or combined form: a noble gas, a halogen, a chalcogen (oxygen, sulfur, selenium or tellurium), nitrogen, phosphorus, carbon or boron.
- (1) Note. Free silicon is considered to be a metal; a metal silicide is considered to be an intermetallic compound or alloy.
- (2) Note. In this and the indented subclasses the presence or absence of hydrogen is ignored.
- (3) Note. The recitation as part of the total composition of a material known to, or generally considered to, contain carbon, such as "steel" or "cast iron", puts the

composition in this or an indented subclass.

- (4) Note. See the notes to subclass 228, especially (3) Note, and to subclass 231 for the distinction between compositions for this class and compositions for Class 106.
- (5) Note. See the notes to subclass 231 for the distinction between compositions for this class and compositions for Class 51 and Class 252.

SEE OR SEARCH CLASS:

- 51, Abrasive Tool Making Process, Material, or Composition, subclasses 307+ for an abrasive tool making process or inorganic material to be used therein.
- 148, Metal Treatment, subclass 24 for flux compositions containing metal and a nonmetal binder or slurring agent to be used in the treatment of solid metal.
- 149, Explosive and Thermic Compositions or Charges, subclass 108.2 for a free metal-containing composition of that class.
- 419, Powder Metallurgy Processes, subclasses 10+ for powder metallurgy processes including a nonmetal and involving sintering.
- 428, Stock Material or Miscellaneous Articles, subclass 539.5 for stock material having interengaged metal and nonmetal continuous phase; subclasses 564 and 565 for metallic composites having metal particles and nonmetal particles; and subclasses 639+ for composite metallic stock in which a component contains oxygen, sulfur, or an organic compound.

231 Molybdenum sulfide or functional constituent, (e.g., lubricant, abrasive, etc.):

This subclass is indented under subclass 230. Composition in which the nonmetal is a molybdenum sulfide or in which a solid, nonmetal component is claimed in functional terms, such as a lubricant, an abrasive, a frictional component, etc.

- (1) Note. Where the functional component is restricted to a specific material other

than MoS_x, the patent is classified in the “nonfunctional” subclass below, appropriate to the material, e.g., diamond as the sole permissible abrasive or graphite as the sole permissible lubricant, are provided for in subclass 243, etc., and is cross-referenced here (subclass 231) if appropriate.

- (2) Note. Where the description of the functional component is of hybrid character, the patent is classified in this subclass only when the component is not specifically provided for below, e.g., an “abrasive oxide” is provided for in subclasses 232+, but a “lubricating sulfide” indicates classification in this subclass (231).

SEE OR SEARCH CLASS:

- 51, Abrasive Tool Making Process, Material, or Composition, subclass 309 for metal-containing compositions which are consolidated products having a metal continuous phase.
- 106, Compositions: Coating or Plastic, subclass 36 for compositions of that class specially designed for the production of a tractive or friction surface.
- 192, Clutches and Power-Stop Control, subclasses 107+ for elements of such devices having modified engaging surfaces.
- 428, Stock Material or Miscellaneous Articles, subclass 564 for brake shoe type composite materials; subclass 687 for metallic stock having a rough surface; and subclass 932 for such stock having an abrasive or cutting feature.
- 508, Solid Anti-Friction Devices, Materials Therefor, Lubricant or Separant Compositions for Moving Solid Surfaces, and Miscellaneous Mineral Oil Compositions, for lubricating compositions, especially subclasses 100+ for rigid lubricants and bearings containing fluid lubricants.

232 Oxide containing:

This subclass is indented under subclass 230. Composition containing oxygen in chemically combined form.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

951, for a collection of patented disclosures having to do with consolidated metal powder compositions having greater than 95 percent theoretical density and containing an oxide.

233 With another nonmetal:

This subclass is indented under subclass 232. Composition containing another nonmetal besides oxygen.

- (1) Note. See the definition of subclass 230, (1) Note, for a list of elements considered to be nonmetals in this classification schedule.
- (2) Note. Nonmetal materials such as borates, carbonates, nitrates, sulfates, etc., are classified herein.

234 Oxygen (O) associated with more than one metal:

This subclass is indented under subclass 232. Composition containing oxides of more than one metal, or containing the oxide of plural metals, e.g., a metal silicate, etc.

- (1) Note. Where all of the metals with which Oxygen (O) is associated are selected from Aluminum (Al), Beryllium (Be), Magnesium (Mg), Alkaline earth metal, Scandium (Sc), Yttrium (Y), Lanthanide metal, Actinide metal, Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) placement of the patent is in subclass 235.
- (2) Note. Included herein are those nonmetal additives such as clay, slag, or spinels, which are a combination of divalent metal oxide and a trivalent metal oxide having the formula $MO.M'2O3$ or $MM'2O4$, not provided for in subclass 235.

235 Oxide of Aluminum (Al), Beryllium (Be), Magnesium (Mg), Alkaline earth metal, Scandium (Sc), Yttrium (Y), Lanthanide

metal, Actinide Metal, Titanium (Ti), Zirconium (Zr), or Hafnium (Hf):

This subclass is indented under subclass 232. Composition in which the oxide is restricted to one or more of alumina, beryllia, magnesia, lime, strontia, baria, titania, zirconia, hafnia, or an oxide of radium, scandium, yttrium, a lanthanide metal or an actinide metal, including thorium and uranium oxide.

- (1) Note. Included herein are those oxides having a free energy of formation (F) at 1,000 C. of greater than 80 kilocalories per gram atom of oxygen. The following table, taken from U.S. Patent 3,377,143, is presented as a guide:

Oxide, F, Oxide, F, Oxide, F

Y_2O 125, Hfo, 105, TiO , 95

CaO 122, CeO_2 , 105, TiO_2 , 85

La_2O_3 , 121, Al_2O_3 , 104, SiO_2 , 78

BeO 120, ZrO_2 , 100, Ta_2O_5 , 75

ThO_2 , 119, BaO , 97, V_2O_3 , 74

MgO , 112, $ZrSiO_4$, 95, NbO_2 , 70

UO_2 105, Cr_2O , O_3 , 62

SEE OR SEARCH CLASS:

- 106, Compositions: Coating or Plastic, subclasses 85+ for inorganic settable compositions.
- 252, Compositions, subclasses 625+ for radioactive compositions in general.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclass 0.5 for shaping or treating radioactive material.
- 501, Compositions: Ceramic, subclasses 94+ for a refractory ceramic composition having a matrix of one or more of the above oxides.

236 Carbide containing:

This subclass is indented under subclass 230. Composition in which the nonmetal is carbon in the form of a carbide.

- (1) Note. This subclass (236) is the locus for a composition under subclass 230 which has a single metal carbide as its sole non-metal component, which carbide is of a metal other than Vanadium (V), Niobium (Nb) or Columbium (Cb), Tantalum (Ta), Chromium (Cr), Molybdenum (Mo), or Tungsten (W).

- (2) Note. The mere designation of a composition or a component of a composition as a "carburized" metal, alloy, or other metal product, is not sufficient for placement of a patent in this subclass; rather, such patent is placed in a subclass providing for elemental carbon, e.g., subclass 243.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 233, for consolidated metal powder compositions containing an oxide as well as a carbide. Where the oxide is a necessary component of the composition, a patent for such composition is not cross-referenced to this subclass or its indented subclasses.

SEE OR SEARCH CLASS:

- 252, Compositions, subclass 62.3 for a barrier layer device composition containing a binary alloy or carbide, and subclass 516 for an electrically conductive or emissive composition containing a carbide.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 603+ for vitrifying or sintering a refractory preform.
- 501, Compositions: Ceramic, subclasses 87+ for ceramic compositions which have a nonmetal matrix and contain a carbide.

237 **With another nonmetal:**

This subclass is indented under subclass 236. Composition containing another nonmetal, other than carbide.

- (1) Note. See the definition of subclass 230, (1) Note, for a list of elements considered to be nonmetals in this classification schedule.

- (2) Note. Free carbon is considered to be "another nonmetal" for this subclass.

SEE OR SEARCH CLASS:

- 125, Stone Working, subclass 11 for dressing of grinding wheels.
- 338, Electrical Resistors, subclass 330 for an electric resistance element integral with a terminal.
- 425, Plastic Article or Earthenware Shaping or Treating: Apparatus, subclass 470 for a shaping or casting surface of that class.

238 **Nonmetal is Boron (B) or Nitrogen (N):**

This subclass is indented under subclass 237. Composition in which the nonmetal other than carbon is restricted to boron and/or nitrogen.

- (1) Note. This definition is meant to include boron carbide as the sole nonmetal component, as well as metal-carbide compositions containing boron nitride as the only additional nonmetal component.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 244, for a consolidated metal powder composition containing B or N without carbide.

SEE OR SEARCH CLASS:

- 419, Powder Metallurgy Processes, subclass 12 for powder metallurgy processes with sintering which include a boride compound; and subclass 13 for similar processes which include a nitride compound.

239 **Carbide only of Vanadium (V), Niobium (Nb) or Columbium (Cb), or Tantalum (Ta):**

This subclass is indented under subclass 236. Subject matter restricted to the carbides of vanadium, niobium (columbium) and/or tantalum.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 236, for similar compositions in which the carbide of a metal other than a Group VB metal may be used alternatively to the carbide of a Group VB metal.

- 241, for a composition in which a Group VB metal carbide is used in addition to the carbide of a metal other than a Group VB metal.
- 240 Carbide only of Chromium (Cr), Molybdenum (Mo), or Tungsten (W):**
This subclass is indented under subclass 236. Subject matter restricted to the carbides of chromium, molybdenum and/or tungsten.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 236, for a similar composition in which the carbide of a metal other than Chromium (Cr), Molybdenum (Mo), or Tungsten (W) may be used alternatively to the carbide of Chromium (Cr), Molybdenum (Mo), or Tungsten (W).
- 241, for a composition in which Chromium (Cr), Molybdenum (Mo), or Tungsten (W) carbide is used in addition to the carbide of a metal other than Chromium (Cr), Molybdenum (Mo), or Tungsten (W).
- 241 Carbon (C) associated with more than one metal:**
This subclass is indented under subclass 236. Composition containing the carbides of more than one metal or containing a carbide of plural metals.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 239, for consolidated metal powder compositions containing carbon associated with two metals, both selected from Vanadium (V), Niobium (Nb) or Columbium (Cb), and Tantalum (Ta) exclusively.
- 240, for consolidated metal powder compositions containing carbon associated with two metals, both selected from Chromium (Cr), Molybdenum (Mo), and Tungsten (W) exclusively.
- SEE OR SEARCH CLASS:
- 204, Chemistry: Electrical and Wave Energy, subclass 294 for a carbon-containing electrolytic electrode composition.
- 242 Free metal is Iron (Fe), Cobalt (Co), or Nickel (Ni) only:**
This subclass is indented under subclass 241. Composition in which the only permissible free (e.g., "cementing") metal is one or more of iron, cobalt and nickel.
- (1) Note. Where other free metals are permitted in the composition, the patent is classified in subclass 241 and is not cross-referenced to this subclass (242).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 241, for compositions in which the binder may contain other metals in addition to, or alternatively to, Iron (Fe), Cobalt (Co) and Nickel (Ni).
- 243 Nonmetal is elemental Carbon (C) only:**
This subclass is indented under subclass 230. Composition in which the only permissible nonmetal component is carbon, and wherein the carbon is not claimed as being part of a chemical compound.
- (1) Note. The claiming of a component of the composition as "steel," "cast iron" or other metal product known to contain carbon as an essential component, e.g., a "carburized" metal or alloy, is sufficient for placement in this subclass (243).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
- 230, for a composition containing elemental carbon plus a nonmetal other than oxide, carbide, boron or nitrogen.
- 231, for a composition wherein elemental carbon (e.g., graphite, diamond) is not claimed as such, but only designated as a lubricant, abrasive, etc.
- 233, for a composition containing elemental carbon in addition to an oxide.
- 237, for a composition containing elemental carbon in addition to a carbide.
- 244, for a composition containing elemental carbon in addition to nitrogen or boron.

SEE OR SEARCH CLASS:

501, Compositions: Ceramic, subclasses 99+ for refractory ceramic compositions containing elemental carbon.

244 Containing Boron (B) or Nitrogen (N):

This subclass is indented under subclass 230. Compositions in which the nonmetal component is boron and/or nitrogen, including boron nitride.

SEE OR SEARCH THIS CLASS, SUBCLASS:

233, for consolidated metal powder compositions containing borax.
 238, for a consolidated metal powder composition containing boron or nitrogen as a carbide or in addition to a metal carbide, or in which the composition has been carbonitrided.
 254, for a loose powder composition containing metal particles and particles which contain boron.

245 Base metal one or more of transition metal:

This subclass is indented under subclass 228. Composition in which half or more of the composition, by weight, comprises one or more, exclusively, of transition elements (i.e., Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Yttrium (Y), Zirconium (Zr), Niobium (Nb) or Columbium (Cb), Molybdenum (Mo), Technetium (Tc), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Silver (Ag), Cadmium (Cd), Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Promethium (Pm), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), Lutetium (Lu), Hafnium (Hf), Tantalum (Ta), Tungsten (W), Rhenium (Re), Osmium (Os), Iridium (Ir), Platinum (Pt), Gold (Au), Mercury (Hg), Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), Lawrencium (Lr), Unnilquadium (Unq), Unnilpentium (Unp), and Unnilhexium (Unh).

SEE OR SEARCH CLASS:

252, Compositions, subclasses 62.3+ for barrier-layer device compositions, and subclass 301.4 for a fluorescent or phosphorescent composition containing a transition metal.
 420, Alloys or Metallic Compositions, for the following alloys made by melting (fusion) techniques; subclasses 417+ for a zirconium base alloy; subclasses 425+ for a niobium (columbium) base alloy; and subclass 427 for a tantalum base alloy.

246 Base metal one or more of Iron group, Copper (Cu), or Noble metal:

This subclass is indented under subclass 245. Composition in which half or more of the composition, by weight, comprises one or more metals selected exclusively from the Iron Group (i.e., Iron (Fe), Cobalt (Co), Nickel (Ni)), Copper (Cu), or Noble metal (i.e., Silver (Ag), Gold (Au), Osmium (Os), Iridium (Ir), Platinum (Pt), Ruthenium (Ru), Rhodium (Rh), and Palladium (Pd)).

(1) Note. Compositions containing steel, cast iron, etc., are considered to be non-metal containing, and are classified in subclasses 230+. See the definition of subclass 230.

SEE OR SEARCH THIS CLASS, SUBCLASS:

28+, for pyrometallurgy of iron and steel.
 123+, for ferrous alloys.

SEE OR SEARCH CLASS:

252, Compositions, subclass 513 for an electrically conductive or emissive composition containing a free metal from the iron group; and subclass 514 for such a composition containing a free noble metal.
 420, Alloys or Metallic Compositions, for the following alloys made by melting (fusion) techniques; subclasses 435+ for a cobalt base alloy; and subclasses 441+ for a nickel base alloy.

247 Base metal one or more of Copper (Cu) or Noble metal:

This subclass is indented under subclass 246. Composition in which half or more of the composition, by weight, comprises one or more, exclusively, of Copper (Cu) or Noble metal (i.e., Silver (Ag), Gold (Au), Osmium (Os), Iridium (Ir), Platinum (Pt), Ruthenium (Ru), Rhodium (Rh), and Palladium (Pd)).

SEE OR SEARCH THIS CLASS, SUBCLASS:

245, for a consolidated metal powder composition which may have a base of a transition metal, other than iron, nickel or cobalt alternative to a copper or noble-metal base.

246, for such composition which may have a base of iron, nickel or cobalt alternative to a copper or noble-metal base.

SEE OR SEARCH CLASS:

252, Compositions, subclass 514 for an electrically conductive or emissive composition containing a noble metal.

420, Alloys or Metallic Compositions, for the following alloys made by melting (fusion) techniques; subclasses 466+ for a platinum base alloy; subclasses 501+ for a silver base alloy; and subclasses 507+ for a gold base alloy.

248 Base metal confined to Tungsten (W):

This subclass is indented under subclass 245. Composition requiring half or more of the composition, by weight, to be tungsten.

(1) Note. Where Tungsten (W) is an alternative base metal to another transition metal, e.g., where the claims allow the base metal to be selected from Tungsten (W) and Molybdenum (Mo), the patent is placed in subclass 245 and is not cross-referenced to this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

245, to complete a search for consolidated metal powder compositions having a tungsten base.

SEE OR SEARCH CLASS:

252, Compositions, subclass 301.5 for a fluorescent or phosphorescent composition containing tungsten, and subclass 515 for an electrically conductive or emissive composition containing free tungsten.

420, Alloys or Metallic Compositions, subclasses 430+ for a tungsten base alloy made by complete melting (fusion) techniques.

249 Base metal one or more of Beryllium (Be), Magnesium (Mg), or Aluminum (Al):

This subclass is indented under subclass 228. Composition in which half or more of the composition, by weight, comprises one or more of aluminum, beryllium, and magnesium.

SEE OR SEARCH THIS CLASS, SUBCLASS:

228, for a consolidated metal powder composition having, as base metal, (1) a nontransition metal other than Al, Be or Mg, (2) Al, Be or Mg only in admixture with another metal, or (3) Al, Be or Mg as an alternative to another metal.

SEE OR SEARCH CLASS:

420, Alloys or Metallic Compositions, for the following alloys made by melting (fusion) techniques; subclass 401 for a beryllium base alloy; subclasses 402+ for a magnesium base alloy; and subclass 528 for an aluminum base alloy.

250 Base metal is Beryllium (Be) only:

This subclass is indented under subclass 249. Subject matter in which the base metal is confined to beryllium.

SEE OR SEARCH THIS CLASS, SUBCLASS:

249, to complete a search for consolidated metal particle compositions which are half or more Be.

252 Mixture contains particles of nonmetal:

This subclass is indented under subclass 255. Subject matter containing, in loose, particulate form, (a) a metal, that is, a pure metal, an alloy,

an intermetallic compound or an agglomerate which is more than half free metal, and (b) a nonmetal, that is, a material which is more than half by weight of a nonmetal element or compound of such element.

- (1) Note. A patent drawn to a mixture having a component provided for in the title of subclasses indented hereunder are placed in the indented subclasses and are not cross-referenced to this subclass, even though the mixture may have components not provided for in the title of the indented subclass.
- (2) Note. The search notes below indicate that the line between this subclass, on the one hand, and Class 106 metal depositing compositions and Class 148 fluxes, on the other hand, depends upon the presence of a nonmetal vehicle in the composition. Such vehicle need not be claimed for original placement of a patent in these other classes where the composition is disclosed as usable only in combination with the vehicle. Such a patent should be cross-referenced here (subclasses 252+).

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 230+, for products resulting from the consolidation of particle mixtures of this subclass, and the definition of subclass 230 for a list of nonmetal elements.
- 256, for consolidated compositions having metal particles distributed in a nonmetal continuous phase, such compositions being designed for use as charges to a metallurgical furnace.

SEE OR SEARCH CLASS:

- 44, Fuel and Related Compositions, subclasses 252+ for a mixture of a particulate metal with a nonmetal which can react exothermically with it by activation with water.
- 106, Compositions: Coating or Plastic, subclass 1.05, for metal-depositing coating compositions which contain metal particles and a nonmetal vehicle which makes a coherent composition, whether liquid, solid, plastic, pasty,

etc., and which facilitates application to a surface to be metallized at ordinary temperatures.

- 148, Metal Treatment, subclass 24 for compositions containing metal particles, a fluxing component, and a nonmetal vehicle which makes a coherent composition, whether liquid, solid, plastic, pasty, etc., and which facilitates application to a solid metal at ordinary temperatures. Subclass 24 also includes methods for fluxing which comprise the mere use of compositions classifiable herein (subclasses 252+).
- 149, Explosive and Thermic Compositions or Charges, especially subclasses 37+, 87 and 108.2 for a mixture of a particulate metal with a nonmetal which can react exothermically with it.
- 228, Metal Fusion Bonding, subclass 224 for a process of surface bonding a metal to another metal or a nonmetal where a powdered filler material, mixed with a flux, is employed. Where a patent claims both the bonding process and an unconsolidated metal particle composition used in the bonding, the patent is placed in Class 228 and cross-referenced here.
- 428, Stock Material or Miscellaneous Articles, subclasses 558 and 560+ for solid welding rods coated with or containing particulate mixtures of the type classified here, or in Class 106, subclass 1.05, or Class 148, subclass 24.

253 Halogen containing particles:

This subclass is indented under subclass 252. Subject matter in which the nonmetal is a halogen (i.e., Fluorine (F), Chlorine (Cl), Bromine (Br), Iodine (I), and Astatine (At)) compound.

- (1) Note. Where the particle mixture contains boron, in free or combined form, as well as a halogen, it is classified in this subclass and not cross-referenced to subclass 254.

254 Boron (B) containing particles:

This subclass is indented under subclass 252. Subject matter in which the nonmetal is boron or a boron compound.

SEE OR SEARCH THIS CLASS, SUBCLASS:

253, for such compositions containing a halogen compound, as well as boron or a boron compound.

255 Loose particulate mixture (i.e., composition) containing metal particles:

This subclass is indented under subclass 300. Composition which comprises loose particles of a metal or alloy mixed with loose particles of a different metal or alloy or with loose particles of a nonmetal.

- (1) Note. Where a patent claims both the powder metallurgy process and the unconsolidated starting material, it is classified as an original in Class 419 and is cross-referenced here.

SEE OR SEARCH THIS CLASS, SUBCLASS:

228+, for such compositions consolidated to a coherent (self-sustaining) shape or form, without total loss of the particulate nature of the unconsolidated mass, that is, without total fusion of all components of the mass. Patents contained in these subclasses (228+) often contain disclosures of loose metal particles and mixtures of the same.

331+, for processes of producing solid particulate free metal directly from liquid metal.

343+, for processes of producing or purifying free metal powder or producing or purifying alloys in powder form.

SEE OR SEARCH CLASS:

106, Compositions: Coating or Plastic, subclasses 403+ for metal particle mixtures to be used as a pigment or filler for such compositions.

228, Metal Fusion Bonding, subclass 248 for a process of surface bonding a metal to another metal or a nonmetal where a powdered filler material is

employed. Where a patent claims both the bonding process and an unconsolidated metal particle composition used in the bonding as a filler, the patent is placed in Class 228 and is cross-referenced here.

252, Compositions, subclasses 181.1+ for "getter" compositions, which may contain metal particles.

417, Pumps, subclasses 48+ for a getter-type pump.

419, Powder Metallurgy Processes, subclasses 1+ for powder metallurgy processes including sintering.

420, Alloys or Metallic Compositions, for a free metal or a single alloy or metallic composition in particulate form.

427, Coating Processes, subclasses 458+ for applying metal particles utilizing an electrostatic charge; subclasses 446+ for plasma spraying processes; subclasses 180+ for other particulate metal coating processes; and subclasses 446+ for flame-spray coating processes. Where a patent claims both the coating process and an unconsolidated metal particle composition used in the process, the patent is classified in Class 427 and cross-referenced here.

428, Stock Material or Miscellaneous Articles, subclasses 403+ for a metal particle coated with a nonmetal, and subclass 570 for composite metal particles (e.g., a powder having one metal coated upon a different metal, etc.).

300 COMPOSITIONS:

This subclass is indented under the class definition. Compositions that are: (A) reactive furnace linings; (B) charges or solid treating compositions, not elsewhere provided, for producing free metal or alloys from metalliferous materials or for treating liquid metal; (C) gaseous and liquid compositions, not elsewhere provided, used in the production of free metal or alloys or used in the treatment of liquid metal; (D) consolidated metal powder compositions having a continuous free metal phase, such as produced by a Class 419 process; (E) loose particulate mixtures (i.e., compositions) containing (a) particles of one free metal mixed with particles of another free metal or alloy; (b)

particles of one alloy mixed with particles of another alloy or (c) particles of free metal or alloy mixed with nonfree metal containing particles and not elsewhere provided.

- (1) Note. Processes of making the compositions of the type mentioned in A, B, or C will be found elsewhere in this class. See "SEARCH THIS CLASS, SUBCLASS" below.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 330, for processes of making a metallurgical treating agent which process does not involve consolidation.
- 746, for processes of making a metallurgical treating agent which process involves consolidation.

SEE OR SEARCH CLASS:

- 44, Fuel and Related Compositions, for fuel compositions intended to provide only heat for a Class 75 or Class 420 operation.
- 48, Gas: Heating and Illuminating, for gas compositions intended to provide only heat for a Class 75 or Class 420 operation.
- 106, Compositions: Coating or Plastic, for metal depositing compositions, coating repellent, polishes, corrosion inhibiting coatings, molding compositions, sodium silicate or hydrosetting compositions, bituminous compositions used for coating metalliferous materials or for agglomerates in general.
- 148, Metal Treatment, for compositions for treating solid metals (e.g., soldering flux, galvanizing flux, welding composition, surface treating compositions, etc.) and subclasses 240+ for reactive coating compositions that react with a metal base to form a coating thereon.
- 149, Explosive and Thermic Compositions or Charges, for exothermic compositions for treating metalliferous materials. Particularly, see subclasses 5+, 20+, 30+ or 37+ for compositions which (1) contain at least one free metal or metalloid and at least one Oxygen (O) supplying material and

(2) are capable of reacting to yield heat and reaction by-products.

- (1) Note. The line between Class 149 and Class 75 is difficult due to the similarity of ingredients in the compositions. If there is a positive recitation of exothermic utility, the original goes to Class 149 even if the composition is used in a Class 75 process. If the composition is used in a Class 75 process and there is no positive recitation of exothermic utility, it goes to Class 75 as an original.

- (2) Note. Patents having claims to both a Class 75 process and a Class 149 composition go to Class 75 as original and are crossed to Class 149.

- 219, Electric Heating, for electric heating devices, particularly subclasses 145.1+ for welding rod or electrode having significant structure and defined by composition.
- 228, Metal Fusion Bonding, for metal fusion bonding means, particularly subclass 56.3 for solder having significant structure or subclass 50 for seam backup means having significant structure.
- 252, Compositions, for physical separation, etching or brightening, descaling, detergents, getters, chemical agents, solids with solution or dispersion aids, solvents, gaseous compositions, preservation agents.
- 420, Alloys or Metallic Compositions, for alloys or metallic compositions having a continuous metal phase.

- (1) Note. Class 420 alloys go as original to Class 420 even if used as treating agents. If a Class 420 material is combined with another ingredient to provide a solid treating composition for liquid metal, the original goes to Class 75, if not provided for elsewhere.

- (2) Note. Consolidated metal powder compositions produced by a Class 419 process go as original to Class

- 75 and are not provided for in Class 420 even though a continuous metal phase may be present.
- 428, Stock Material or Miscellaneous Articles, for material or articles having some structure. See section 5 for the relationship between Class 428 and the composition classes. In general, when claims mention the article by name only and define it in terms of composition, the original goes to the composition class.
- (1) Note. Welding rods or welding electrodes defined only in terms of composition are placed in Class 75 subclass 302. Flux defined by composition in wire form or in a container go as original to Class 75 subclass 304 unless there is significant structural description.
- 501, Compositions: Ceramic, for glass and refractory compositions containing metalliferous materials.
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for catalysts or solid sorbents that contain metalliferous materials.
- 301 Reactive furnace lining:**
This subclass is indented under subclass 300. Furnace lining composition that is used for intentional reactivity with metalliferous materials in the furnace to produce beneficiated or refined ore, charge or free metal.
- 302 Welding rod or electrode defined by composition:**
This subclass is indented under subclass 300. A welding rod or electrode defined by composition and without significant structure.
- SEE OR SEARCH CLASS:
219, Electric Heating, subclasses 146.1+ for welding rod compositions.
420, Alloys or Metallic Compositions, if the welding rod without significant structure contains only elemental metal and no other ingredients (e.g., flux, etc.).
428, Stock Material or Miscellaneous Articles, subclasses 385+ for metal substrate with weld modifying coating.
- 303 Solid treating composition for liquid metal (e.g., flux, slagging agent, casting agent, etc.) or charge:**
This subclass is indented under subclass 300. Composition which is a solid treating composition for liquid metal or a charge for producing metal or treating liquid metal.
- (1) Note. The composition herein does not encompass ore, per se, or alloy, per se. Another ingredient utilized in producing or refining of metal must be present with the ore or alloy to be acceptable to this composition subclass.
- 304 In wire, container, or article with surface feature:**
This subclass is indented under subclass 303. Composition that is in a wire, in a container, or in an article defined by surface feature (e.g., groove, openings, etc.) which aids in the utilization or dispersement of the charge or treating agent.
- (1) Note. The recitation of a shape other than wire or article with surface feature is insufficient for classification in this subclass. Thus, pellet, briquette, cube, etc., are placed elsewhere under subclass 303.
- 305 For casting or teeming operation:**
This subclass is indented under subclass 303. Composition for treating molten metal in the mold or while being poured in the mold.
- (1) Note. Patents having claims to both a Class 164 process and a Class 75 composition go to Class 164 as original and are crossed to Class 75.
- SEE OR SEARCH CLASS:
164, Metal Founding, for processes of treating molten metal in a teeming or casting operation.
- 306 For electrothermic operation (e.g., electroslag remelting, etc.):**
This subclass is indented under subclass 303. Composition for use in electrothermic processes (e.g., electroslag remelting, etc.).

- 307 Containing Boron (B) compound:**
This subclass is indented under subclass 303. Composition containing a Boron (B) compound (e.g., Borax, Boron halide, Boron carbide, etc.).
- 308 Containing Halide:**
This subclass is indented under subclass 303. Composition containing a binary compound of a metal and a Halogen.
- 309 Containing Fluoride:**
This subclass is indented under subclass 308. Composition wherein the Halogen is Fluorine (F) (e.g., Fluorspar, Fluorite, etc.).
- 310 And consolidated:**
This subclass is indented under subclass 309. Composition wherein the Fluoride is in consolidated form produced by agglomerating, calcinating, compacting, indurating, sintering, or solidifying from a molten mass.
- 311 And consolidated:**
This subclass is indented under subclass 308. Composition wherein the Halide is in consolidated form produced by agglomerating, calcinating, compacting, indurating, sintering, or solidifying from a molten mass.
- 312 Containing Carbide:**
This subclass is indented under subclass 303. Composition containing a Carbide (e.g., Calcium carbide, Silicon carbide, etc.).
- 313 Composition for or from consolidating by agglomerating, calcinating, compacting, indurating, roasting, sintering, or solidifying from molten mass:**
This subclass is indented under subclass 303. Composition which is: (1) intended for consolidation by agglomerating, calcinating, indurating, sintering, or solidifying from molten mass; (2) consolidated composition produced by agglomerating, calcinating, compacting, indurating, sintering, or solidifying from a molten mass, or (3) composition derived from materials which were consolidated by agglomerating, calcinating, compacting, indurating, sintering, or solidifying from a molten mass.
- (1) Note. This subclass takes as original consolidated metalliferous compositions amenable to Class 75 or Class 420 refining or alloying operation unless an intended use divergent from a Class 75 or Class 420 refining or alloying operation is the expressed use.
- (2) Note. The consolidated composition may be a coated composition or may contain more than one layer. However, coated compositions produced by processes not involving agglomerating, calcinating, compacting, indurating, sintering or solidifying from molten mass go elsewhere under subclass 303 if they are coated charges, or coated solid treating compositions for molten metal.
- 314 Containing free metal:**
This subclass is indented under subclass 313. Consolidated composition that contains metal in the zero valent or free metal state.
- 315 Aluminum (Al) or Magnesium (Mg) as free metal:**
This subclass is indented under subclass 314. Composition wherein Aluminum (Al) or Magnesium (Mg) is the free metal.
- 316 Iron (Fe), Iron scrap, or Iron alloy as free metal:**
This subclass is indented under subclass 314. Composition containing Iron (Fe), Iron scrap, or Iron alloy wherein Iron is the free metal.
- 317 And coal, coke, pitch, asphalt, or tar:**
This subclass is indented under subclass 316. Composition which contains coal, coke, pitch, asphalt, or tar.
- 318 And clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate:**
This subclass is indented under subclass 316. Composition which contains clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate.
- 319 Containing Iron (Fe) compound:**
This subclass is indented under subclass 313. Composition containing an Iron compound.
- 320 And coal, coke, pitch, asphalt, or tar:**
This subclass is indented under subclass 319. Composition which contains coal, coke, pitch, asphalt, or tar.

321 And synthetic polymer, natural polymer, or carbohydrate:

This subclass is indented under subclass 319. Composition which contains synthetic polymer, natural polymer, or carbohydrate.

322 And clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate:

This subclass is indented under subclass 319. Composition which contains clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate.

323 And Alkaline earth metal compound or Aluminum (Al) compound:

This subclass is indented under subclass 319. Composition containing an Alkaline earth metal compound or Aluminum (Al) compound.

324 Containing Zinc (Zn) compound:

This subclass is indented under subclass 313. Composition containing a Zinc (Zn) compound.

325 Containing coal, coke, pitch, asphalt, or tar:

This subclass is indented under subclass 313. Composition which contains coal, coke, pitch, asphalt, or tar.

326 Containing clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate:

This subclass is indented under subclass 313. Composition which contains clay (e.g., bentonite, montmorillonite, etc.), cement, or Alkali metal silicate.

327 Containing Alkaline earth metal compound or Aluminum (Al) compound:

This subclass is indented under subclass 313. Composition containing an Alkaline earth metal compound or Aluminum (Al) compound.

328 Containing free metal:

This subclass is indented under subclass 303. Composition that contains metal in the zero valent or free metal state.

329 Containing Alkaline earth metal compound or Aluminum (Al) compound:

This subclass is indented under subclass 303. Composition containing an Alkaline earth metal compound or Aluminum (Al) compound.

330 PROCESSES:

This subclass is indented under the class definition. Processes not otherwise provided for.

(1) Note. This class has no miscellaneous subclass as such, thus this subclass serves as the miscellaneous process subclass.

(2) Note. Among others, some patents may be found in this subclass which claim only a process of making a metallurgical treating agent which process does not involve consolidation.

331 Producing solid particulate free metal directly from liquid metal (e.g., liquid comminuting, etc.):

This subclass is indented under subclass 330. Process in which liquid free metal is comminuted to form discrete particles and solidified in its comminuted form.

SEE OR SEARCH THIS CLASS, SUBCLASS:

355, for processes of comminuting a liquid solution or dispersion to obtain a discrete powder form.

SEE OR SEARCH CLASS:

117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, especially subclasses 75, 87, 205, and 921, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metals, which are in the form of whiskers.

264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclasses 5+ for processes of forming solid particulate material directly from molten or liquid mass wherein a material other than metal is comminuted or for processes in which the claims are broad or nondefinitive as to material and the disclosure states that materials other than metal are processed by the invention. Patents having claims to forming solid particulate metal and claims to forming solid particulate nonmetal or patents having generic

claims with a disclosure to forming solid particulate metal and to forming solid particulate nonmetal will go as originals to Class 264 and a cross-reference will be placed in Class 75.

332 With subsequent coating of the particles:

This subclass is indented under subclass 331. Process in which the solidified particles are coated.

SEE OR SEARCH CLASS:

427, Coating Processes, subclasses 212+ for processes of coating particles, flakes, or granules.

333 Utilizing centrifugal force or rotating forming zone to comminute liquid metal:

This subclass is indented under subclass 331. Process in which the liquid metal is comminuted by use of centrifugal force or by use of a revolving or rotating surface.

334 Including directing liquid metal onto rotating disc:

This subclass is indented under subclass 333. Process in which liquid metal is directed against a rotating thin, flat, circular plate.

335 By vibrating or agitating:

This subclass is indented under subclass 331. Process in which the particles are formed by agitation or vibration of the liquid metal to fling or shake off the particles.

336 Utilizing electrothermic energy to comminute:

This subclass is indented under subclass 331. Process in which electrothermic energy is employed to comminute the liquid metal into particles.

337 By impinging plural liquid streams:

This subclass is indented under subclass 331. Process in which the particles are formed by causing plural liquid streams to collide forcibly.

- (1) Note. The liquid streams may be of the particle forming metal only or of both particle forming metal and nonparticle forming material.

338 By impinging or atomizing with gaseous jet or blast:

This subclass is indented under subclass 331. Process in which the particles are formed by impinging with or directing a jet or blast of a gas into contact with the liquid metal.

339 Gas used is air:

This subclass is indented under subclass 338. Process in which the gas used is air.

340 By extrusion spraying or gravity fall through orifice:

This subclass is indented under subclass 331. Process in which the particles are formed by flowing or allowing the liquid metal to fall through an orifice.

341 Into moving fluid:

This subclass is indented under subclass 340. Process in which the formed particles pass into or through moving fluid medium.

342 Spheroidizing or rounding of existing solid metal particles:

This subclass is indented under subclass 330. Process in which solid, irregular, or nonspherical particulate metal is reshaped wherein the irregularities are diminished or the particles are caused to become more spherical or rounded in shape without loss of metal therefrom and by means other than use of a mold or shaping surface therefore and in which the individual and separate identities of the particles are maintained.

- (1) Note. Patents in this subclass are generally directed to those processes in which heat is employed to soften the particles so as to permit the internal cohesive forces of the particles to effect the reshaping as defined.

SEE OR SEARCH CLASS:

148, Metal Treatment, particularly subclass 513 for processes of treating loose metal particles to modify or maintain internal physical structure (i.e., microstructure) or chemical properties thereof. In this context, it is important to note that spheroidizing, in terms of microstructure, is a Class 148 operation and that spheroidizing

of Class 75 refers to the macrostructure.

- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, subclass 15 for spheroidizing or rounding of solid, nonmetallic particles. Patents having claims to spheroidizing or rounding of solid metal particles and claims to spheroidizing or rounding of solid, nonmetal particles or patents having generic claims with a disclosure to spheroidizing or rounding of solid, metal particles and to spheroidizing or rounding of solid, nonmetallic particles will go as originals to Class 264 and a cross-reference will be placed in Class 75.

343 Producing or purifying free metal powder or producing or purifying alloys in powder form (i.e., named or of size up to 1000 microns in its largest dimension):

This subclass is indented under subclass 330. Process in which a free metal powder is produced or purified or in which alloys in powder form are produced or purified.

- (1) Note. In order for a patent to be classified in this subclass, or the subclasses hereunder indented, the claims or disclosure must specifically state that a powder is produced or is purified. A "precipitate" is not considered to be a "powder" for purposes of classification in these subclasses.
- (2) Note. "Powder" is defined as a mass of particles, that is, portions of matter so small that they are not ordinarily handled as individual units. According to Metals Handbook, 8th Edition, 1961, Volume I, page 28, metallic powders then used in powder metallurgy had a particle size up to 1,000 microns in their largest dimension, as determined by screens or other suitable instruments. Powder particles generally are distinguished from filamentary particles in that their shape and length-to-diameter ratio are such that in the dry state the particles will not hold together as a coherent article without the application of pressure or heat, that is, will not become entangled.

- (3) Note. If a patent states that a "powder" is produced or purified, the patent is to be placed here regardless of any designation of the size of the "powder".

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 711, for processes in which nonmetallic material which is liquid under standard conditions is used to form a precipitate.

SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, especially subclasses 75, 87, 205, and 921, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metals, which are in the form of whiskers.
- 148, Metal Treatment, subclasses 240+ for processes in which a reactive coating is produced on solid metal.
- 148, Metal Treatment, subclass 11.5 for processes in which a powder metal or powder alloy is subjected to working and heat treatment.
- 148, Metal Treatment, subclass 126.1 for processes in which a particulate metal or particulate alloy is subjected to heat treatment.
- 419, Powder Metallurgy Processes, subclasses 30+ for processes which include preliminary significant treatment, preparation, or manufacture of the powder, prior to any compacting or sintering.
- 427, Coating Processes, subclasses 212+, for processes in which a particulate metal or particulate alloy is coated.

344 Radioactive:

This subclass is indented under subclass 343. Process in which the free metal or alloy or metallic composition is radioactive.

345 Utilizing electrothermic, magnetic, or wave energy:

This subclass is indented under subclass 343. Process in which electrothermic, magnetic, or wave energy is used.

- 346 Utilizing plasma:**
This subclass is indented under subclass 345. Process in which a wholly or partially charged mixture of gaseous ions and electrons (i.e., plasma) is the source of energy.
- 347 Utilizing magnetism:**
This subclass is indented under subclass 345. Process in which magnetism is used.
- 348 Producing or purifying named magnetic material:**
This subclass is indented under subclass 343. Process in which a named magnetic material (i.e., the magnetic properties are specified) is purified without modifying or altering the magnetic properties or is produced.

SEE OR SEARCH CLASS:
148, Metal Treatment, subclass 105 for processes in which the material is in particulate form at the time its magnetic properties are altered, as well as at the end of the process.
- 349 Using Phosphorus(P), Boron (B), or Silicon (Si) or compound thereof:**
This subclass is indented under subclass 348. Process in which Phosphorus(P), Boron (B) or Silicon (Si) or compound thereof is used.
- 350 Using Alkaline earth metal or compound thereof:**
This subclass is indented under subclass 348. Process in which an Alkaline earth metal (i.e., Calcium (Ca), Strontium (Sr), Barium (Ba)) or compound thereof is used.
- 351 Producing alloy:**
This subclass is indented under subclass 343. Process in which an alloy is produced in powder form.

(1) Note. Patents which claim both a process of making an alloy and a process of making a powder alloy are classified as originals in Class 75 and a cross-reference will be placed in Class 420.
- 352 Including comminution:**
This subclass is indented under subclass 351. Process in which comminution is used in the production of the powder form.
- 353 Utilizing scrap material:**
This subclass is indented under subclass 343. Process in which scrap material is used as a starting material.
- 354 Including comminution:**
This subclass is indented under subclass 343. Process in which a liquid mass or solid is comminuted to obtain a discrete powder form.

SEE OR SEARCH THIS CLASS, SUBCLASS:
331+, for processes of producing solid particulate free metal directly from liquid metal.

SEE OR SEARCH CLASS:
241, Solid Material Comminution or Disintegration, subclasses 1+ for processes of comminuting a solid without a metallurgical step.
- 355 Directly from liquid mass (e.g., by atomizing, etc.):**
This subclass is indented under subclass 354. Process in which a liquid solution or dispersion is comminuted to form discrete powder and is solidified in its comminuted form. A reduction of a metal compound to free metal can occur at any stage of the process.
- 356 And shaping or sintering prior to comminution:**
This subclass is indented under subclass 354. Process in which the solid is shaped or sintered prior to comminution.
- 357 With step at 300 degrees C or greater:**
This subclass is indented under subclass 354. Process in which at least one process step is performed at a temperature of 300 degrees C or greater.
- 358 Use of salt bath:**
This subclass is indented under subclass 357. Process in which a salt melt is used.
- 359 Reduction:**
This subclass is indented under subclass 357. Process in which a metal compound is reduced to free metal.

- 360 Use of gas:**
This subclass is indented under subclass 357. Process in which gas is used.
- 361 Using nonmetallic material which is liquid under standard conditions:**
This subclass is indented under subclass 354. Process in which at least one process step is performed using a nonmetallic material which is liquid under standard conditions.
- 362 Decomposition of organo-compound containing metal or metal carbonyl:**
This subclass is indented under subclass 343. Process in which an organo-compound containing metal or a metal carbonyl is reduced to form a free metal powder.
- 363 At 300 degrees C or greater:**
This subclass is indented under subclass 343. Process in which at least one process step is performed at a temperature of 300 degrees C or greater.
- 364 Combined with step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions:**
This subclass is indented under subclass 363. Process in which at least one step is performed at less than 300 degrees C using a nonmetallic material which is liquid under standard conditions.
- 365 Step at 300 degrees C or greater after step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions:**
This subclass is indented under subclass 364. Process in which at least two distinct process steps are performed. The process step at less than 300 degrees C using a nonmetallic material which is liquid under standard conditions precedes the process step in which the temperature is 300 degrees C or greater.
- 366 Utilizing a fluidized bed:**
This subclass is indented under subclass 363. Process in which a material undergoing treatment is in a highly dispersed state in a gaseous medium.
- 367 Vaporizing or condensing free metal:**
This subclass is indented under subclass 363. Process in which the metal or alloy or metallic composition is vaporized or condensed.
- 368 Settling of powder in molten metal or salt bath:**
This subclass is indented under subclass 363. Process in which a free metal settles as a powder from a molten metal or salt bath.
- 369 Purifying powdered metal or reducing powdered metal compound to free metal:**
This subclass is indented under subclass 363. Process in which powdered metal is purified or a powdered metal compound is reduced.
- 370 Using nonmetallic material which is liquid under standard conditions:**
This subclass is indented under subclass 343. Process in which a nonmetallic material which is liquid under standard conditions is used.
- 371 And settling of free metal from solution:**
This subclass is indented under subclass 370. Process in which a free metal settles as a powder from a solution.
- 372 Displacing by another metal (i.e., electromotive series):**
This subclass is indented under subclass 371. Process in which the settling of free metal powder occurs by displacement of a first metal in a compound by a second metal which is more positive in the electromotive series than the first metal.
- 373 Copper (Cu) recovered:**
This subclass is indented under subclass 371. Process in which the metal that is recovered by displacement is Copper (Cu).
- 374 Nickel (Ni) or Cobalt (Co) recovered:**
This subclass is indented under subclass 371. Process in which the metal that is recovered by displacement is Nickel (Ni) or Cobalt (Co).
- 375 Process control responsive to sensed condition:**
This subclass is indented under subclass 330. Process in which the operation is regulated by perceiving a characteristic or a change in a characteristic of the material or the apparatus

- and implementing an action in the process based upon the measured characteristic.
- 376 Removing material from process to sense condition:**
This subclass is indented under subclass 375. Process in which a sample is taken from the process to determine a characteristic or a change in a characteristic of the material in order to regulate the process.
- 377 Material removed is molten metal:**
This subclass is indented under subclass 376. Process in which the sample taken from the process is molten metal.
- 378 Pressure sensed:**
This subclass is indented under subclass 375. Process in which the pressure of the material is determined.
- 379 Of feed gas:**
This subclass is indented under subclass 378. Process in which the pressure of a gas being fed to the process is determined.
- 380 Temperature sensed:**
This subclass is indented under subclass 375. Process in which the temperature of the material is determined.
- 381 Of waste gas:**
This subclass is indented under subclass 380. Process in which the temperature of the waste gas is determined.
- 382 Of molten metal:**
This subclass is indented under subclass 380. Process in which the temperature of the molten metal is determined.
- 383 Of sintered material:**
This subclass is indented under subclass 380. Process in which the temperature of the sintered material is determined.
- 384 Composition sensed:**
This subclass is indented under subclass 375. Process in which the composition of the material is determined.
- 385 Of waste gas:**
This subclass is indented under subclass 384. Process in which the composition of the off-gas is determined.
- 386 Characteristic of treated material sensed (e.g., density, etc.):**
This subclass is indented under subclass 375. Process in which a physical or mechanical characteristic of the treated material is determined.
- 387 Flow rate sensed:**
This subclass is indented under subclass 375. Process in which the flow rate of the material is determined.
- 388 Preparing for amalgamation, preparing and amalgamating or breaking amalgam to produce free metal:**
This subclass is indented under subclass 330. Process which is a (1) preparatory chemical process for producing an intermediate for amalgamation, (2) preparatory chemical process followed by amalgamation or (3) chemical or physiochemical process of breaking the amalgam thus formed to liberate the desired free metal (e.g., sublimation of mercury, dissolution or displacement of the metal from the amalgam, etc.).
- (1) Note. The term amalgamation under this subclass and subclasses indented hereunder is restricted to a species of amalgamation which requires the use of liquid metal (e.g., mercury, lead, zinc, alloy, etc.) to collect, to alloy or to adhere to a desired free metal without heat-melting the desired free metal.
- SEE OR SEARCH CLASS:
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, appropriate subclasses for electrolytic treatment of noble metal containing material or solutions thereof.
- 209, Classifying, Separating, and Assorting Solids, for the "so called" amalgamation processes for separation, per se, of metals (e.g., noble metal, etc.) from metal containing materials (e.g., ore, etc.).

- 423, Chemistry of Inorganic Compounds, for chemical processes of treating noble metal containing materials and including treating amalgam or amalgamation steps that result in a metal compound as a product and without a free metal product.
- 389 And displacing with a metal other than Mercury (Hg):**
This subclass is indented under subclass 388. Process wherein a more electropositive free metal displaces a less electropositive metal from solution in a free metal form, while the more electropositive metal is not Mercury (Hg).
- (1) Note. See the definitions of the class for displacement and the electromotive series, per se.
- 390 Utilizing a Halogen containing agent:**
This subclass is indented under subclass 388. Process wherein a Halogen containing agent (e.g., Chlorine, Hydrochloric acid, Sodium iodide, etc.) is used at any stage in the process.
- 391 Utilizing a Nitrogen (N) containing agent:**
This subclass is indented under subclass 388. Process wherein a Nitrogen (N) containing agent (e.g., salt peter, Nitric acid, Ammonium sulfate, Nitrogen dioxide, etc.) is used at any stage in the process.
- 392 Producing or treating free metal:**
This subclass is indented under subclass 330. Process wherein elemental metal is produced from metal compounds, such as ore, or wherein elemental metal is treated by a process not provided for elsewhere.
- (1) Note. This and indented subclasses provide for a process of removing a component from a pre-existing alloy (e.g., purification, etc.).
- (2) Note. Processes in which metal is treated in the molten state are specifically included hereunder.
- SEE OR SEARCH CLASS:
148, Metal Treatment, appropriate subclasses for processes of treating solid or semi-solid metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties of metal. However, if metal casting, welding, machining, or working is involved, there is a requirement of significant heat treatment as described in section III, A, of the Class 148 definition.
- 393 Utilizing Radioactive material, producing or treating Radioactive metal:**
This subclass is indented under subclass 392. Process in which a Radioactive material is used to produce or to treat a free metal, in which a Radioactive metal (i.e., Technetium (Tc), Promethium (Pm), Polonium (Po), Francium (Fr), Radium (Ra), Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nobelium (No), Lawrencium (Lr), Unnilquadium (Unq), Unnilpentium (Unp), Unnilhexium (Unh)) is produced, or in which a metal that contains a Radioactive metal is treated.
- SEE OR SEARCH CLASS:
420, Alloys or Metallic Compositions, for processes for making a Radioactive alloy.
- 394 Thorium (Th):**
This subclass is indented under subclass 393. Process in which Thorium (Th) is produced, a metal that contains Thorium is treated, or a material that contains Thorium is used to produce or to treat a free metal.
- 395 Reduction:**
This subclass is indented under subclass 394. Process in which a Thorium (Th) compound is reduced to metal.
- 396 Plutonium (Pu):**
This subclass is indented under subclass 393. Process in which Plutonium (Pu) is produced, a metal that contains Plutonium is used to produce or to treat a free metal.
- 397 Reduction:**
This subclass is indented under subclass 396. Process in which a Plutonium (Pu) compound is reduced to metal.

398 Uranium (U):

This subclass is indented under subclass 393. Process in which Uranium (U) is produced, a metal that contains Uranium is treated, or a material that contains Uranium is used to produce or to treat a free metal.

399 Reduction:

This subclass is indented under subclass 398. Process in which a Uranium (U) compound is reduced to metal.

400 Free metal production from sea nodules:

This subclass is indented under subclass 392. Process wherein elemental metal is produced from metalliferous lumps found on the bed of the sea. These lumps are usually high in manganese.

SEE OR SEARCH CLASS:

423, Chemistry of Inorganic Compounds, subclasses 49+, for a process of obtaining a manganese compound or manganese values from sea nodules without reduction to elemental metal.

401 Treating multi-component metal-containing scrap having an integral substrate to separate metal therefrom by temperature modification or chemical process at 300 degrees C or greater wherein at least one metal remains solid during separation:

This subclass is indented under subclass 392. Process in which a multicomponent metal-containing scrap having an integral substrate is separated to recover metal. During the separation at least one metal remains solid. The separation is performed by changing the temperature of the scrap or by chemically processing the scrap at 300 degrees C or greater.

- (1) Note. The following criteria will be used to define the word "scrap": (A) If a patent refers to a material as scrap, then the material will be assumed to be scrap. (B) If a patent does not refer to a material as scrap (e.g., metal borings, tin cans, etc.); but it can be inferred from the patent that metal, not a specific article, is recovered, then the material will be assumed to be scrap. (C) If it is unclear as to the nature of the material being treated (e.g., tin plate, etc.), the material

will be assumed to be scrap. (D) If there is a positive statement indicating that an "article" is recovered, then the "article" is not "scrap" and the patent is classified elsewhere (e.g., removing metal compounds from engine parts, removing tin from a can to reuse the can, etc.).

SEE OR SEARCH THIS CLASS, SUBCLASS:

711+, for processes of recovering metal from multicomponent metal-containing scrap having an integral substrate in which a nonmetallic material which is liquid under standard conditions is used.

SEE OR SEARCH CLASS:

29, Metal Working, subclasses 403.1+, for separation of materials one from another in which the separation is done to salvage a portion of a specific article for reuse.

134, Cleaning and Liquid Contact With Solids, for processes of separating metal from metal or metal from non-metal to clean a specific article for reuse (e.g., the cleaning of gun bores by the removal of metal fouling the same, etc.). If a base is cleaned and the removed metal is recovered, the original will go to Class 75 and a cross-reference will be placed in Class 134.

423, Chemistry of Inorganic Compounds, subclasses 90+, for detinning in which a Tin (Sn) compound is produced.

521, Synthetic Resins or Natural Rubbers, subclasses 40+, for processes of treating scrap or waste product containing solid organic polymer to recover a solid polymer therefrom.

402 Utilizing molten salt bath:

This subclass is indented under subclass 401. Process in which a molten salt bath is used in the separation.

403 Removing nonmetal from metal:

This subclass is indented under subclass 401. Process in which a material other than free metal is removed from metal.

- 404 Separating liquid metal by centrifuging:**
This subclass is indented under subclass 392. Process in which an apparatus consisting essentially of a compartment spun about a central axis is used to separate liquid metal.
- SEE OR SEARCH CLASS:
164, Metal Founding, subclasses 114+, for use of centrifugal force when shaping liquid metal against a forming surface.
- 405 Removing gas from liquid metal by use of gas permeable membrane:**
This subclass is indented under subclass 392. Process in which the liquid metal containing a gas is contacted with one side of a gas permeable membrane to selectively permeate the gas through the membrane to remove the gas from the liquid metal.
- SEE OR SEARCH CLASS:
95, Gas Separation: Processes, subclass 46 for processes of removing a gas from a liquid other than a liquid metal by use of selective diffusion of gases through a substantially solid barrier (e.g., semipermeable membrane, etc.).
- 406 Adsorbing impurity from vaporous or liquid metal:**
This subclass is indented under subclass 392. Process in which a contaminant is removed from vaporous or liquid metal by contacting the metal with a material that has an affinity for the contaminant such that the contaminant adheres to the reactive surfaces of the material.
- 407 Filtering vaporous or liquid metal:**
This subclass is indented under subclass 392. Process in which vaporous or liquid metal passes through a filter.
- 408 Alkali metal, singly or in combination:**
This subclass is indented under subclass 407. Process in which the vaporous or liquid metal contains over 50 percent by weight of an Alkali metal (i.e., Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs)), singly or in combination.
- 409 Magnesium (Mg):**
This subclass is indented under subclass 407. Process in which the vaporous or liquid metal contains over 50 percent by weight Magnesium (Mg).
- 410 Noble metal, singly or in combination:**
This subclass is indented under subclass 407. Process in which the vaporous or liquid contains over 50 percent by weight of a Noble metal (i.e., Ruthenium (Ru), Rhodium (Rd), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)), singly or in combination.
- 411 Copper (Cu):**
This subclass is indented under subclass 407. Process in which the vaporous or liquid metal contains over 50 percent by weight Copper (Cu).
- 412 Aluminum (Al):**
This subclass is indented under subclass 407. Process in which the vaporous or liquid metal contains over 50 percent by weight Aluminum (Al).
- 413 From metal carbonyl or Carbon monoxide complex:**
This subclass is indented under subclass 392. Process in which free metal is obtained from a metal carbonyl or a Carbon monoxide complex.
- 414 At 300 degrees C or greater (e.g., pyrometallurgy, etc.):**
This subclass is indented under subclass 392. Process of producing or treating free metal wherein at least one step of the process takes place at a temperature of over 300 degrees C.
- (1) Note. This and indented subclasses contain subject matter often referred to in the art as pyrometallurgy.
- 415 Foam:**
This subclass is indented under subclass 414. Process which produces a metal product which has a mass of pores.
- (1) Note. The pores may either be interconnected or closed cells.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, subclass 613 for porous or foamed metallic stock material.

416 Combined with step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions (e.g., hydrometallurgy, etc.):

This subclass is indented under subclass 414. Process wherein a step at over 300 degrees C is combined with a step at less than 300 degrees C the latter step employing a nonmetallic material which is a liquid under standard conditions. The steps may take place in any order.

- (1) Note. This subclass generally provides for a step of pyrometallurgy combined with a step of hydrometallurgy.

417 Obtaining metal from photographic waste:

This subclass is indented under subclass 416. Process wherein the source of metal is photographic waste.

- (1) Note. Examples of photographic waste are scrap film and spent photographic solutions. The metal recovered is usually silver.

SEE OR SEARCH CLASS:

430, Radiation Imagery Chemistry: Process, Composition, or Product Thereof, for a process which includes a photographic step or which prepares a composition for that class combined with a step of recovering metal. An example of a process for Class 430 is a process of recovering silver from a photographic developing solution to regenerate the solution for further use.

418 Obtaining metal from electrolytic slime:

This subclass is indented under subclass 416. Process wherein the source of metal is the slime that accumulates on the bottom of electrolytic cells during electrolysis.

419 Step at less than 300 degrees C using nonmetallic material which is liquid under stan-

dard conditions after a step at 300 degrees C or greater:

This subclass is indented under subclass 416. Process wherein a step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions occurs after a step at 300 degrees C or greater.

420 Step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions is reduction to free metal:

This subclass is indented under subclass 419. Process wherein reduction to free metal occurs in a step at less than 300 degrees C using nonmetallic material which is liquid under standard conditions, which step is after a step at over 300 degrees C.

421 Noble metal:

This subclass is indented under subclass 420. Process wherein the free metal produced is a Noble metal.

422 Silver (Ag):

This subclass is indented under subclass 421. Process wherein the Noble metal produced is Silver (Ag).

423 Gold (Au):

This subclass is indented under subclass 421. Process wherein the Noble metal produced is Gold (Au).

424 Copper (Cu):

This subclass is indented under subclass 420. Process wherein the free metal produced is Copper (Cu).

425 Iron (Fe), Cobalt (Co), or Nickel (Ni):

This subclass is indented under subclass 420. Process wherein the free metal produced is Iron (Fe), Cobalt (Co), or Nickel (Ni).

426 Noble metal obtained:

This subclass is indented under subclass 416. Process wherein the metal obtained is a Noble metal.

427 Silver (Ag):

This subclass is indented under subclass 426. Process wherein the metal obtained is Silver (Ag).

428 Gold (Au):

This subclass is indented under subclass 426. Process wherein the metal obtained is Gold (Au).

429 Copper (Cu) obtained:

This subclass is indented under subclass 416. Process wherein the metal obtained is Copper (Cu).

430 Iron (Fe), Cobalt (Co), or Nickel (Ni) obtained:

This subclass is indented under subclass 416. Process wherein the metal obtained is Iron (Fe), Cobalt (Co), or Nickel (Ni).

431 Zinc (Zn), Cadmium (Cd), or Mercury (Hg) obtained:

This subclass is indented under subclass 416. Process wherein the metal obtained is Zinc (Zn), Cadmium (Cd), or Mercury (Hg).

432 Tin (Sn) or Lead (Pb) obtained:

This subclass is indented under subclass 416. Process wherein the metal obtained is Tin (Sn) or Lead (Pb).

433 Iron (Fe):

This subclass is indented under subclass 414. Process in which Iron (Fe) is produced or a metal that contains over 50 percent by weight Iron is treated.

- (1) Note. The term “reducing” as used below in indented subclasses means that over 50 percent of the metallic Iron produced in the process must be obtained by reduction of an Iron compound (e.g., ore, etc.).
- (2) Note. This and indented subclasses provide for treating a metal that contains over 50 percent by weight Iron in the molten state and melting a metal that contains over 50 percent by weight Iron.
- (3) Note. This subclass contains patents drawn to processes of preheating ferrous scrap for subsequent metallurgical processing without actual melting.
- (4) Note. Production of a ferroalloy, such as ferromanganese, ferrochromium, or

nickeliferous pig Iron, where the percentage of the metals is unspecified will go as originals to the nonferrous metal subclass regardless of the fact that Iron (Fe) may be produced in the production of the ferroalloy. If the percentages of metals are specified the original will go to Class 420, Alloys or Metallic Compositions.

SEE OR SEARCH CLASS:

- 148, Metal Treatment, appropriate subclasses for processes of treating solid or semi-solid metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties of metal. See Class 148, subclass 512, for processes including surface melting of the solid or semi-solid metal. However, if casting, welding, machining, or working is involved, there is a requirement of significant heat treatment as described in section III, A, of the Class 148 definition.
- 420, Alloys or Metallic Compositions, subclass 88 for process of preparing ferrophosphorus whether or not any proportions are specified.
- 420, Alloys or Metallic Compositions, subclass 117 for processes of preparing ferrosilicon containing over 50 percent Iron or wherein no relative proportions of Iron and Silicon are disclosed.
- 420, Alloys or Metallic Compositions, subclass 121 for processes of preparing ferroboron containing over 50 percent Iron or wherein no relative proportions of Iron and Boron are specified.
- 420, Alloys or Metallic Compositions, subclass 578 for processes of preparing ferrosilicon containing over 50 percent Silicon.
- 420, Alloys or Metallic Compositions, subclass 591 for processes of preparing ferroboron containing over 50 percent Boron.

- 434 With concurrent production of hydraulic cement:**
This subclass is indented under subclass 433. Process wherein an inorganic material intended to harden by addition of water is produced concurrently with Iron (Fe).
- 435 With concurrent production of Titanium dioxide:**
This subclass is indented under subclass 433. Process wherein Titanium dioxide (TiO₂) is produced concurrently with Iron (Fe).
- 436 With consolidation (e.g., pelletizing, etc.) of solid metallic Iron (Fe) product after reduction:**
This subclass is indented under subclass 433. Process wherein a solid elemental Iron (Fe) containing product is consolidated (e.g., pelletized, briquetted, etc.) after being reduced. This is usually done to decrease surface area and thus inhibit oxidation.
- 437 Reducing Iron (Fe) halide:**
This subclass is indented under subclass 433. Process wherein a compound of Iron (Fe) and Halogen (e.g., Iron halide, etc.) is reduced to yield metallic Iron.
- 438 Making wrought Iron (Fe):**
This subclass is indented under subclass 433. Process for making the commercial product called "wrought Iron (Fe)" which is a very low Carbon (C) (less than 0.1%) Iron intimately admixed with a slag. The conventional process heats molten pig Iron in a reverberatory furnace. The Carbon is burned out causing the Iron to become pasty, at which point it is rolled into balls and worked to remove excess slag.
- 439 Pouring molten Iron (Fe) into molten slag (i.e., aston process):**
This subclass is indented under subclass 438. Process wherein molten low Carbon (C) Iron (Fe) is poured into molten slag. The Iron becomes intimately mixed with the slag and then settles, carrying with it some slag. Liquid slag is poured off and the pasty Iron-slag mixture is worked to yield wrought Iron.
- 440 Utilizing moving hearth:**
This subclass is indented under subclass 438. Process wherein the Iron (Fe) is treated on a moving hearth (e.g., rocking, etc.).
- 441 Directly from Iron (Fe) compound only (no metallic Iron):**
This subclass is indented under subclass 438. Process wherein over 50 percent of the Iron (Fe) in the final wrought Iron product is added to the process as an Iron compound, such as ore, instead of in the metallic state.
- 442 In moving furnace:**
This subclass is indented under subclass 441. Process in which the wrought Iron (Fe) is prepared in a furnace which moves during the process (e.g., rocking, rotating, etc.).
- 443 Reducing in gaseous suspension:**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound, generally in particulate form, is reduced to elemental Iron while suspended in a gas.
- 444 Fluidized bed:**
This subclass is indented under subclass 443. Process wherein particulate Iron (Fe) compound (e.g., ore, etc.) is kept in motion and suspended by the upward flow of gas, the suspension acting much like a fluid.
- 445 With melting of Iron (Fe):**
This subclass is indented under subclass 444. Process which includes melting of the metallic Iron (Fe) produced.
- 446 Outside the fluidized bed:**
This subclass is indented under subclass 445. Process wherein the metallic Iron (Fe) produced in the fluidized bed is melted outside the fluidized bed.
- 447 With solid in fluidized bed in addition to reducible Iron (Fe) compound:**
This subclass is indented under subclass 444. Process wherein the fluidized bed contains a solid material in addition to the reducible Iron (Fe) compound.
- 448 Carbon (C):**
This subclass is indented under subclass 447. Process wherein the solid is Carbon (C).

- 449 Generated in situ:**
This subclass is indented under subclass 448. Process wherein the Carbon (C) is not added in solid form, but solid Carbon is generated in the fluidized bed by chemical reaction.
- (1) Note. The Carbon may be generated by cracking natural gas.
- (2) Note. To be placed in this subclass there must be a specific claim that solid Carbon is generated in the fluidized bed. Cases of doubt will be resolved in favor of placement in another subclass under 444.
- 450 Using plural fluidized bed furnaces:**
This subclass is indented under subclass 444. Process in which the solid material passes from one fluidized bed furnace to another.
- 451 Using plural fluidized bed zones within a furnace:**
This subclass is indented under subclass 444. Process which employs two or more separate fluidized bed zones within a single outer shell.
- 452 Solid product produced (without melting):**
This subclass is indented under subclass 443. Process in which solid elemental Iron (Fe) is produced without melting.
- 453 Cyclone apparatus used:**
This subclass is indented under subclass 443. Process wherein gas containing a suspension of Iron compound or reduced Iron compound is introduced into an apparatus tangentially so as to create a swirl. This apparatus may be used to effect reduction or to separate the Iron (Fe) produced from the gas.
- 454 Using same inlet to feed solid and gas:**
This subclass is indented under subclass 443. Process wherein the solid to be reduced and a reducing gas are fed into the apparatus, where reduction occurs, through the same inlet.
- 455 Inlet is a burner:**
This subclass is indented under subclass 454. Process wherein the gas is combustible and is ignited immediately upon leaving the inlet.
- (1) Note. This and the indented subclass include so called “flash smelting”.
- 456 Burner is horizontal:**
This subclass is indented under subclass 455. Process wherein the inlet projects the solid-gas mixture into the apparatus horizontally.
- 457 Inlet feeds upwardly:**
This subclass is indented under subclass 454. Process wherein the gas and solid are fed to the reducing apparatus in an upward direction.
- 458 Blast furnace reduction to produce molten Iron (Fe):**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound is reduced in a shaft furnace with solid reductant, normally coke, with a preheated forced blast of gas containing gaseous Oxygen, normally air. A blast furnace is operated in a continuous manner, with additional burden (i.e., solid Iron compound, reductant, and flux) being added at the top of the furnace as the burden is consumed. Preheated gas containing gaseous Oxygen (the “blast”) is added under pressure through tuyeres just above the level of molten Iron and slag produced by the reduction.
- 459 Using additive to the blast:**
This subclass is indented under subclass 458. Process wherein an additional substance other than ambient air is intentionally added to the blast forced under pressure through the tuyeres.
- 460 Carbonaceous:**
This subclass is indented under subclass 459. Process wherein the added substance contains Carbon (C) in any form (free or combined).
- 461 Slurry of solid in liquid:**
This subclass is indented under subclass 460. Process wherein the carbonaceous additive is a solid suspended in a liquid, one or both of the solid and liquid containing Carbon (C) in any form (free or combined).
- 462 Liquid:**
This subclass is indented under subclass 460. Process wherein the carbonaceous additive is a liquid at ordinary room temperature.

- 463 Gaseous:**
This subclass is indented under subclass 460. Process in which the carbonaceous additive is a gas at ordinary temperature and pressure.
- 464 Recycled off gas:**
This subclass is indented under subclass 463. Process wherein the carbonaceous gas is taken from the top of the blast furnace and recycled to the tuyeres.
- 465 Water:**
This subclass is indented under subclass 459. Process wherein water is added to the blast.
- (1) Note. The water may be added as a liquid or a vapor.
- 466 Oxygen enrichment:**
This subclass is indented under subclass 459. Process wherein the blast contains more gaseous oxygen than the ambient air.
- 467 Tapping molten product:**
This subclass is indented under subclass 458. Process including a step of tapping a molten product from the blast furnace (e.g., molten Iron, slag, etc.).
- 468 Top gas recovery:**
This subclass is indented under subclass 458. Process which includes a step of handling, treating, or using the gas which comes off the top of the blast furnace after passing through the burden (e.g., by recovering a byproduct, removing pollutants, or recovering heat, etc.).
- 469 Specified method of charging burden:**
This subclass is indented under subclass 458. Process in which the charging of solid material at the top of the furnace is recited in more detail than a single step of nominal charging.
- 470 Defined composition of slag:**
This subclass is indented under subclass 458. Process wherein the composition of the molten slag produced in the process is of a defined composition other than nominal "slag."
- 471 Defined composition of reductant:**
This subclass is indented under subclass 458. Process wherein the composition of the reductant of the Iron (Fe) compound is defined as other than nominal coke.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
460, for a process of adding carbonaceous material through the tuyeres with the oxygen containing blast, which material may be a reductant.
- 472 Defined composition of Iron (Fe) source:**
This subclass is indented under subclass 458. Process wherein the composition of the Iron (Fe) source is specified.
- (1) Note. Mere nominal "ore" is excluded.
- 473 Reduction in closed retort (e.g., Hogenas process, etc.):**
This subclass is indented under subclass 433. Process wherein no substance is added to the batch during the reduction (e.g., heating a closed mixture of ore and Carbon (C), etc.).
- (1) Note. The closed retort may be a container, as in the Hogenas process.
- 474 Reduction in rotary kiln:**
This subclass is indented under subclass 433. Process wherein a reducible Iron (Fe) compound is reduced to metallic Iron in an approximately cylindrical vessel rotating on its axis. The axis is horizontal or inclined less than 45 degrees from horizontal. The vessel rotates in only one direction through an angle of over 360 degrees during the reduction and rotates substantially continuously.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
484, for reduction in an apparatus which does not rotate over 360 degrees or oscillates back and forth during the reduction.
- 475 With melting of Iron (Fe) product:**
This subclass is indented under subclass 474. Process wherein the metallic Iron (Fe) product is melted.

- 476 Iron (Fe) product melted within rotary kiln:**
This subclass is indented under subclass 475. Process wherein the Iron (Fe) product is melted within the rotary kiln.
- 477 Introducing solid reductant into rotary kiln:**
This subclass is indented under subclass 474. Process wherein a solid substance which reduces an Iron (Fe) compound to metallic Iron is introduced into the rotary kiln.
- (1) Note. The solid reductant may be charged by itself or in admixture with other ingredients.
- 478 Solid reductant is recycled:**
This subclass is indented under subclass 477. Process wherein solid reductant discharged from the rotary kiln is recycled back into the rotary kiln.
- (1) Note. The solid reductant is usually discharged from the kiln with Iron (Fe), separated from the Iron (Fe), and then recycled.
- 479 Any part of the charge is consolidated by agglomerating, compacting, indurating, or sintering (e.g., pelletized ore, flux, or reductant, etc.):**
This subclass is indented under subclass 477. Process wherein any or all components of the material charged into the rotary kiln are consolidated by agglomerating, compacting, indurating, or sintering.
- (1) Note. The components such as ore, flux, or reductant may be separately consolidated or several ingredients may be combined and consolidated together (e.g., pellets of combined ore and coke, etc.).
- 480 Reducible Iron (Fe) compound and solid reductant fed through same end of rotary kiln:**
This subclass is indented under subclass 477. Process wherein solid reductant and reducible Iron (Fe) compound are fed into the rotary kiln from the same end of the kiln.
- 481 Mixed prior to charging:**
This subclass is indented under subclass 480. Process in which reducible Iron (Fe) compound and solid reductant are mixed together prior to charging and the mixture is then charged.
- 482 With generation of gaseous reductant outside rotary kiln:**
This subclass is indented under subclass 474. Process employing a gaseous reductant which is generated outside the rotary kiln in a separate device (e.g., coal gasifier, etc.).
- 483 Superposed multiple hearth reduction:**
This subclass is indented under subclass 433. Process in which a reducible Iron (Fe) compound is passed downwardly from one hearth to another hearth located immediately below during its reduction to metallic Iron. Usually there are three or more superposed hearths with the reducible Iron compound passing downward from hearth to hearth during the process.
- 484 Moving furnace or hearth (e.g., moving belt, etc.):**
This subclass is indented under subclass 433. Process which employs a furnace wherein the part containing or supporting the reducible Iron (Fe) compound moves during the reduction. The movement need not be continuous, but may be intermittent only.
- (1) Note. The furnace or hearth must move during the reduction. Movement merely to charge or discharge the contents is not enough for this subclass and is placed below on another basis.
- (2) Note. If the part of the furnace which supports the reducible Iron (Fe) compound moves during the reduction, classification is proper thereunder even if the heating apparatus is stationary (e.g., charge on moving belt in furnace, etc.).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
473, for batch reduction system wherein closed containers of reductant and reducible Iron compound are pushed through a kiln.

- 485 Reduction in molten state:**
This subclass is indented under subclass 484. Process wherein some material is molten during the reduction (e.g., slag, Iron, etc.) and ingredients for carrying out the reduction are added to the melt.
- 486 Heating reduction zone by heat conducted through walls of zone:**
This subclass is indented under subclass 433. Process wherein a reducible Iron (Fe) compound is reduced in a zone in which at least part of the heat required for the reduction is supplied by conduction through the walls of the zone (e.g., external heating of apparatus, etc.).
- 487 Shaft furnace:**
This subclass is indented under subclass 486. Process wherein the apparatus whose exterior is heated is a shaft furnace.
- 488 Reduction to metallic Iron (Fe) within shaft furnace:**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound is reduced in a shaft furnace.
- 489 Externally supplied gas reductant:**
This subclass is indented under subclass 488. Process wherein a gaseous reductant is introduced into the shaft furnace from outside the furnace.
- (1) Note. This and indented subclasses do not exclude the presence of solid reductant in the shaft furnace as long as a gaseous reductant is also supplied to the furnace from outside.
- 490 Solid Iron (Fe) produced within shaft furnace:**
This subclass is indented under subclass 489. Process wherein an Iron (Fe) compound is reduced to solid metallic Iron within the shaft furnace without melting the so produced Iron.
- (1) Note. The processes in this and indented subclasses are sometimes referred to as “direct reduction”.
- 491 With melting Iron (Fe) product outside shaft furnace:**
This subclass is indented under subclass 490. Process wherein the solid Iron (Fe) produced in the shaft furnace is melted outside the shaft furnace.
- 492 With gasification of solid carbonaceous material in melt (e.g., coal, etc.):**
This subclass is indented under subclass 491. Process wherein coal is added to the molten Iron (Fe) and a gas (usually Oxygen or air) is passed through the melt to convert the coal in the melt to a reducing gas which is then employed in the shaft furnace reduction.
- 493 Using solid Carbon (C) to generate gas in separate furnace (e.g., Wiberg process, etc.):**
This subclass is indented under subclass 490. Process wherein the gaseous reductant is manufactured from solid Carbon (C) in a furnace separate from the shaft furnace in which reduction to metallic Iron (Fe) takes place.
- 494 Solid Carbon (C) is coal:**
This subclass is indented under subclass 493. Process in which the solid Carbon (C) employed to generate reducing gas is coal.
- 495 Direct addition of gas containing gaseous Oxygen or water to shaft furnace (e.g., continuous HyL process, etc.):**
This subclass is indented under subclass 490. Process wherein a gas containing gaseous Oxygen or Water is added directly to the shaft furnace without being admixed with or reacted with another material before the addition.
- 496 With reformation of reducing gas in separate furnace (e.g., Midrex process, etc.):**
This subclass is indented under subclass 490. Process in which a reducing gas is reacted in a separate furnace to change its chemical composition prior to being introduced into the shaft furnace.
- (1) Note. As an example, Methane is reacted with Carbon dioxide to yield Carbon monoxide and Hydrogen.

- 497 With plural reformers (e.g., Purofer process, etc.):**
This subclass is indented under subclass 496. Process wherein two or more reforming furnaces are employed.
- 498 With addition of steam to reformer (e.g., Armco process, etc.):**
This subclass is indented under subclass 496. Process wherein steam is added to the reformer as a reactant.
- 499 Molten Iron (Fe) produced in shaft furnace:**
This subclass is indented under subclass 488. Process wherein the Iron (Fe) produced in the shaft furnace is melted in the shaft furnace.
- 500 Reduction in molten state:**
This subclass is indented under subclass 433. Process wherein some material is molten during the reduction (e.g., slag, Iron, etc.), and ingredients for carrying out the reaction are added to the melt.
- 501 Gas injection below surface of melt:**
This subclass is indented under subclass 500. Process wherein a gas is injected below the surface of the melt wherein reduction is taking place.
- 502 Gas injection over surface of melt (e.g., as in reverberatory furnace, etc.):**
This subclass is indented under subclass 500. Process wherein gas is passed over the surface of the melt.
- (1) Note. This gas may be a reducing flame as in a reverberatory furnace.
- 503 Reduction in presence of solid Carbon (C) containing material (e.g., coke, coal, carbides, etc.):**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound is reduced to metallic Iron in the presence of a solid containing Carbon. The Carbon may be either in elemental (e.g., coke, coal, etc.) or combined (e.g., carbide, etc.) form.
- 504 Including consolidation of solid Carbon (C) containing material with reducible Iron (Fe) compound:**
This subclass is indented under subclass 503. Process wherein the solid Carbon (C) containing material and a reducible Iron (Fe) compound are consolidated together before or during the reduction of the Iron compound.
- (1) Note. In some instances the Iron compound is only partially reduced and the resulting partially reduced consolidated product is intended to be used in the charge of a further reduction system (e.g., a blast furnace, etc.).
- 505 Reduction with externally applied gas (e.g., batch HyL process, etc.):**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound is reduced to metallic Iron by a gas which is added to the Iron compound from outside the apparatus in which the Iron compound is reduced.
- (1) Note. Gas generated by in situ reactions within the apparatus containing the Iron compound is not “externally applied” for purposes of this class.
- 506 Reduction in the presence of liquid carbonaceous reductant (e.g., petroleum, pitch, etc.):**
This subclass is indented under subclass 433. Process wherein an Iron (Fe) compound is reduced in the presence of a carbonaceous substance added in a liquid state to the apparatus containing the Iron compound.
- 507 Melting Iron (Fe) or treating molten Iron:**
This subclass is indented under subclass 433. Process wherein a metal that contains over 50 percent by weight Iron (Fe) is melted or is treated in the molten state (e.g., to purify it or to improve its properties, etc.).
- (1) Note. The solid Iron which is melted or the molten Iron which is treated is predominately (over 50 percent) in the elemental state at the start of the process. The “reduction” subclasses above take processes wherein a charge which is predominately an Iron compound is reduced

to the metallic state. This and indented subclasses, however, will take a process of melting or treating a charge which is predominately metallic Iron even though some incidental reduction of an Iron compound takes place (e.g., melting rusty scrap with reduction of the rust, treating pig Iron of high Carbon content with Iron oxide whereby the Iron oxide oxidizes the Carbon and is reduced to metallic Iron, etc.) as long as less than 50 percent of the Iron in the final product is produced by the incidental reduction.

- (2) Note. This and indented subclasses will take a process of removing a component from an Iron alloy to make another alloy.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 433, for a process of preheating Iron (e.g., preheating scrap for later melting, etc.).

SEE OR SEARCH CLASS:

- 148, Metal Treatment, appropriate subclasses for processes of treating solid or semi-solid metal to modify or maintain the internal physical structure (i.e., microstructure) or chemical properties of metal. See Class 148, subclass 512, for processes of surface melting of the solid or semi-solid metal. However, if metal casting, metal fusion, machining or working is involved, there is a requirement of significant heat treatment as described in section III, A, of the Class 148 definition.

- 420, Alloys or Metallic Compositions, for a process of making an alloy by melting the ingredients together.

508 Vacuum treatment of molten Iron (Fe):

This subclass is indented under subclass 507. Process wherein a molten metal that contains over 50 percent by weight Iron (Fe) is treated in a gas pressure significantly less than one atmosphere pressure.

- (1) Note. The low pressure must be intentional in order to treat the molten metal. Merely melting metal where atmospheric pressure is low will not cause a

patent to be placed hereunder, unless the low pressure is intentionally employed to treat the molten metal.

509 Free falling stream or spray of molten Iron (Fe):

This subclass is indented under subclass 508. Process wherein an unconfined stream or spray of a molten metal that contains over 50 percent by weight Iron (Fe) is treated in a vacuum.

- (1) Note. In a process for this subclass the stream or spray remains molten during treatment and then coalesces after treatment to form a pool of molten metal.

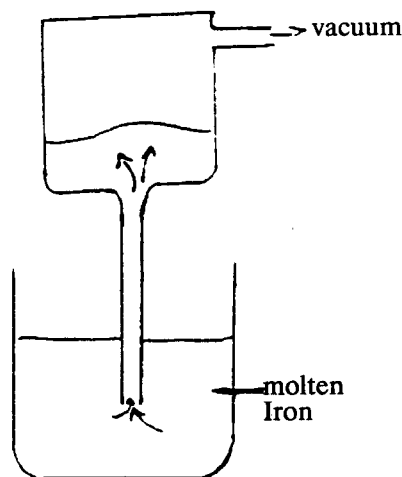
SEE OR SEARCH THIS CLASS, SUBCLASS:

- 331+, for a process wherein a spray of molten metal is solidified while falling and is recovered as solid particles of metal.

510 Vacuum lift:

This subclass is indented under subclass 508. Process in which a vacuum causes a molten metal that contains over 50 percent by weight Iron (Fe) to be lifted above the level of the container in which it is held.

- (1) Note. A common arrangement is as shown:



511 With addition of gas:

This subclass is indented under subclass 510. Process wherein a gas is intentionally added to the molten metal that contains over 50 percent by weight Iron (Fe) while it is being treated by lifting under a vacuum.

- (1) Note. The gas must be added intentionally, mere accidental leakage is ignored. The amount of gas added is restricted so that the pressure of gas over the molten metal remains significantly under one atmosphere.

512 With addition of gas:

This subclass is indented under subclass 508. Process wherein a gas is intentionally added to the molten metal that contains over 50 percent by weight Iron (Fe) while it is being treated under vacuum.

- (1) Note. The gas must be added intentionally, mere accidental leakage is ignored. The amount of gas added is restricted so that the pressure of gas over the molten metal remains significantly under one atmosphere.

513 In reverberatory furnace (e.g., open-hearth, Siemens-Martin, puddling, etc.):

This subclass is indented under subclass 507. Process which is carried out in a reverberatory furnace. A reverberatory furnace is one in which solid fuel is not burned in contact with the liquid or solid metal that contains over 50 percent by weight Iron (Fe). There is a roof over the hearth in which the metal is melted or the molten metal is treated, and either solid fuel is burned next to the hearth, but under the roof, by which means heat is reflected onto the metal by the roof, or in which gaseous fuel is burned over the metal in the hearth and heat is reflected down onto the hearth by the roof.

- (1) Note. Common names of furnaces which are reverberatory are for example, open-hearth, Siemens-Martin and puddling.

514 With treating of molten Iron (Fe) with gas outside reverberatory furnace (e.g., in Bessemer converter, etc.):

This subclass is indented under subclass 513. Process including a step wherein a gas is injected into, onto, or through molten metal that contains over 50 percent by weight Iron (Fe) or a slag layer thereon while the molten metal is outside the reverberatory furnace. This step may take place prior to or subsequently to treatment of the metal in a reverberatory furnace.

- (1) Note. Commonly, patents in this subclass employ a combination of treatment in an open hearth furnace with treatment in a Bessemer converter.

515 With melting Iron (Fe) in shaft furnace:

This subclass is indented under subclass 513. Process in which the melting of solid metal that contains over 50 percent by weight Iron in a shaft furnace is combined with a process step taking place in a reverberatory furnace.

- (1) Note. Most patents in this subclass are drawn to a process of melting metal in a shaft furnace (e.g., cupola, etc.), and passing the molten metal to a reverberatory furnace for treatment.

516 Using gaseous Oxygen in a higher concentration than in ambient air:

This subclass is indented under subclass 513. Process which employs a gas which has a higher concentration of Oxygen than that of ambient air for any purpose.

- (1) Note. The higher concentration of Oxygen may be employed to burn fuel in the furnace or it may be injected separately onto molten metal that contains over 50 percent by weight Iron (Fe) by a lance extending through the roof of the reverberatory furnace.

517 With addition of solid elemental Carbon (C) or employing elemental Carbon furnace lining:

This subclass is indented under subclass 513. Process in which solid elemental Carbon (C) is present in the reverberatory furnace at any time during the melting of metal that contains over

- 50 percent by weight Iron (Fe) or treatment of molten metal that contains over 50 percent by weight Iron, or in which the reverberatory furnace employs a lining which includes elemental Carbon.
- 518 With compound containing Alkali metal and Oxygen (e.g., Sodium nitrate, Sodium carbonate, etc.):**
This subclass is indented under subclass 513. Process wherein a compound containing Alkali metal and Oxygen (e.g. Sodium nitrate, Sodium carbonate, etc.) is present in the reverberatory furnace at any time during the process.
- 519 With Halogen or Halogen containing compound (e.g., Sodium chloride, Fluorspar, etc.):**
This subclass is indented under subclass 513. Process wherein elemental Halogen or a Halogen compound is present in the reverberatory furnace at any time during the process.
- 520 With Alkaline earth metal or Magnesium (Mg) containing compound:**
This subclass is indented under subclass 513. Process wherein an Alkaline earth metal compound or a Magnesium (Mg) compound is present in the reverberatory furnace at any time during the process.
- (1) Note. The presence of an Alkaline furnace lining (e.g., magnesia brick, etc.) will be disregarded for purposes of this subclass.
- 521 With Transition metal compound:**
This subclass is indented under subclass 513. Process wherein a compound of a Transition metal (i.e., Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Yttrium (Y), Zirconium (Zr), Niobium (Nb) or Columbium (Cb), Molybdenum (Mo), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Silver (Ag), Cadmium (Cd), Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), Lutetium (Lu), Hafnium (Hf), Tantalum (Ta), Tungsten (W), Rhenium (Re), Osmium (Os), Iridium (Ir), Platinum (Pt), Gold (Au), and Mercury (Hg)) is present in the reverberatory furnace at any time during the process.
- (1) Note. The presence of a Transition metal compound in the furnace lining will be disregarded for purposes of this subclass unless there is a specific disclosure that it interacts in some way with the charge of Iron (Fe).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
393+, for a process which employs a Radioactive material whether or not the Radioactive material becomes part of the final product.
- 522 Iron oxide:**
This subclass is indented under subclass 521. Process wherein the Transition metal compound contains only Iron (Fe) and Oxygen (O).
- 523 Melting solid Iron (Fe):**
This subclass is indented under subclass 513. Process wherein solid metal that contains over 50 percent by weight Iron (Fe) is melted in the reverberatory furnace.
- 524 Sequential treatment of molten Iron (Fe) in plural apparatus with different linings (e.g., acid Bessemer followed by basic Bessemer, etc.):**
This subclass is indented under subclass 507. Process wherein premelted metal that contains over 50 percent by weight Iron (Fe) is treated in one apparatus and then transferred to another apparatus and treated wherein there is an intentional, claimed difference in the linings between the different apparatus.
- (1) Note. Any recited intentional difference will be enough to render the linings different (e.g., one lining "acidic" and the other "basic", etc.).
- 525 Impinging free falling molten metal stream or spray with a gas or solid agent or spraying (e.g., atomizing, etc.) of molten metal:**
This subclass is indented under subclass 507. Process wherein a free falling molten metal stream or spray is impinged during free fall with a gas or solid agent or wherein a molten

metal is sprayed (e.g., atomized, etc.) to treat the molten metal.

- (1) Note. If a molten metal stream or spray is directed onto solid treating agent in a container or through a slag layer or used to mix separately added solid treating agent into molten metal, placement goes elsewhere under subclass 507.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 509, for treating a free falling stream of molten metal that contains over 50 percent by weight Iron (Fe) in a vacuum.

526 Adding solid treating agent in form of wire, rod, or article with surface feature or in container or by plunging means:

This subclass is indented under subclass 507. Process wherein the solid treating agent is added in the form of a wire, rod, or article with a surface feature or in a container or a process wherein the solid treating agent is added to the molten metal that contains over 50 percent by weight Iron (Fe) by an apparatus or device that mechanically plunges the solid treating agent into the molten metal.

527 In rotary kiln (e.g., Kaldo process, etc.):

This subclass is indented under subclass 507. Process wherein a gas or solid treating agent is injected into premelted metal that contains over 50 percent by weight Iron (Fe) or slag thereon and wherein the premelted metal is agitated at any molten process stage by a chamber or converter that rotates 360 degrees.

528 Injecting gas or nonmetalliferous liquid which gasifies into, onto, or through premelted Iron (Fe) or slag layer thereon:

This subclass is indented under subclass 507. Process wherein a gas or nonmetalliferous liquid that gasifies (e.g., oil, Water, etc.) under the operating conditions is injected into, onto, or through the premelted metal that contains over 50 percent by weight Iron (Fe) or slag layer thereon.

- (1) Note. The injection of gas before or during the melting is not considered part of the subject matter under this subclass or the indented subclasses hereinbelow.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 571, for a process wherein gas is used to melt or is injected during the melting of a metal that contains over 50 percent by weight Iron (Fe).

529 With hydrocarbon liquid or gas present:

This subclass is indented under subclass 528. Process wherein a liquid or gaseous compound consisting only of Carbon (C) and Hydrogen (H) (e.g., Propane, Butane, petroleum, etc.) is present during the treatment of the premelted metal that contains over 50 percent by weight Iron (Fe).

- (1) Note. The hydrocarbon must be involved in direct or indirect treatment of the molten metal or slag layer thereon and must be present after the melting stage. Use of hydrocarbon liquid or gas for melting is not sufficient for this subclass.

530 And hydrocarbon in surrounding relationship to gaseous Oxygen (e.g., hydrocarbon in outer concentric tube, etc.):

This subclass is indented under subclass 529. Process wherein a liquid or gaseous hydrocarbon is in a surrounding relationship to oxygen gas or an oxygen gas containing gas composition (e.g., hydrocarbon in outer concentric tube, etc.).

- (1) Note. Hydrocarbon used as a shielding or protective gas surrounding Oxygen gas or air is included in this subclass.

531 And adding solid agent, slag, or flux to premelted Iron (Fe) or slag layer thereon:

This subclass is indented under subclass 528. Process wherein premelted metal that contains over 50 percent by weight Iron (Fe) or slag layer thereon is contacted with a solid treating agent, a separately prepared slag, or flux.

- (1) Note. Classification is based on the agent, slag, or flux added to the molten metal or slag layer thereon and not on the composition of the in situ generated slag or solid agents initially present before melting or added during melting.

- (2) Note. The addition of molten metal to a solid agent, slag, or flux is acceptable in this subclass.
- 532 Loose elemental Carbon (C), coal, or coke (e.g., carburizing, etc.):**
This subclass is indented under subclass 531. Process wherein the solid agent added to the molten metal that contains over 50 percent by weight Iron (Fe) or slag layer thereon is loose elemental Carbon (C), coal, or coke.
- (1) Note. This subclass will take the use of loose Carbon, coal, or coke for carburizing, but is not limited to carburizing.
- (2) Note. If the Carbon, coal, or coke is part of a consolidated composition containing other treating agents, classification goes elsewhere under subclass 531.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
536, 537, 542, 543, 566, or 567, for the use of a metal carbide or a high carbon metal as a carburizing or treating agent.
561, for the use of elemental Carbon (C), coal, or coke in treating molten metal or slag layer thereon in absence of a gas or liquid treating agent.
- 533 With solid entrained in gas or injected by gas pressure:**
This subclass is indented under subclass 531. Process wherein a solid agent is entrained in or injected by gas pressure.
- (1) Note. In this and the herein below indented subclasses, classification is based on the solid treating agent, slag, or flux added to the premelted metal or slag layer whether or not the solid is the entrained solid.
- 534 Boron (B) or compound thereof used in process:**
This subclass is indented under subclass 533. Process wherein Boron (B) or compound thereof is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 535 Metal halide used in process:**
This subclass is indented under subclass 533. Process wherein a metal halide (e.g., Sodium chloride, Fluorspar, etc.) is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 536 Carbide used in process:**
This subclass is indented under subclass 533. Process wherein a binary Carbon (C) compound of a metal (i.e., Carbide) is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 537 Elemental metal or elemental Silicon (Si) used in process:**
This subclass is indented under subclass 533. Process wherein elemental metal (e.g., scrap, Iron (Fe), Magnesium (Mg), Aluminum (Al), etc.) or elemental Silicon (Si) is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 538 Iron (Fe) containing compound used in process:**
This subclass is indented under subclass 533. Process wherein an Iron (Fe) containing compound (e.g., ore, scale, Iron oxide, etc.) is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 539 Alkali metal compound or Alkaline earth metal compound used in process:**
This subclass is indented under subclass 533. Process wherein an Alkali metal compound (e.g., Sodium hydroxide, Sodium carbonate, etc.) or an Alkaline earth metal compound (e.g., Calcium oxide, Calcium carbonate, etc.) is present in the solid agent, separately prepared slag, or flux used for treating at any process stage.
- 540 Gas contains gaseous Oxygen:**
This subclass is indented under subclass 531. Process wherein Oxygen gas or Oxygen gas containing composition (e.g., air, etc.) is the injected gas.

- 541 Metal halide:**
This subclass is indented under subclass 540. Process wherein a metal halide (e.g., Sodium chloride, Fluorspar, etc.) is present in the solid agent, separately prepared slag, or flux.
- 542 Carbide:**
This subclass is indented under subclass 540. Process wherein a binary Carbon (C) compound of a metal (i.e., Carbide) is present in the solid agent, separately prepared slag, or flux.
- 543 Elemental metal or elemental Silicon (Si):**
This subclass is indented under subclass 540. Process wherein elemental metal (e.g., scrap, Iron (Fe), Magnesium (Mg), Aluminum (Al), etc.) or elemental Silicon (Si) is present in the solid agent, separately prepared slag, or flux.
- 544 Iron (Fe) containing compound:**
This subclass is indented under subclass 540. Process wherein an Iron (Fe) containing compound (e.g., ore, scale, Iron oxide, etc.) is present in the solid agent, separately prepared slag, or flux.
- 545 Alkali metal compound or Alkaline earth metal compound:**
This subclass is indented under subclass 540. Process wherein an Alkali metal compound (e.g., Sodium hydroxide, Sodium carbonate, etc.) or an Alkaline earth metal compound (e.g., Calcium oxide, Calcium Carbonate, etc.) is present in the solid agent, separately prepared slag, or flux.
- 546 Noble gas or inert gas not otherwise identified:**
This subclass is indented under subclass 531. Process wherein a Noble gas (i.e., Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), or Xenon (Xe)) or an inert gas not otherwise identified is the injected gas.
- (1) Note. If the injected gas is named (e.g., Carbon dioxide, etc.), it is classified by the named gas even if the specification calls the gas inert.
- 547 Gas compound containing Oxygen (e.g., Carbon monoxide, Carbon dioxide, Water, etc.):**
This subclass is indented under subclass 531. Process wherein the injected gas is a compound containing Oxygen (e.g., Carbon monoxide, Carbon dioxide, Water, etc.).
- SEE OR SEARCH THIS CLASS, SUBCLASS:
540+, or 548+, for gaseous compositions containing Oxygen gas such as air or Oxygen gas enriched gas compositions.
- 548 Gas contains gaseous Oxygen:**
This subclass is indented under subclass 528. Process wherein Oxygen gas or an Oxygen gas containing composition (e.g., air, etc.) is the injected gas.
- 549 With treatment of exhaust gas:**
This subclass is indented under subclass 548. Process wherein the exhaust or waste gas from the process is treated separately from the molten metal that contains over 50 percent by weight Iron (Fe).
- 550 And adding gaseous Oxygen or inert gas to exhaust gas:**
This subclass is indented under subclass 549. Process wherein gaseous Oxygen is added with the exhaust gas or wherein an inert gas is added to the exhaust gas.
- (1) Note. If the added gaseous Oxygen reacts with the exhaust gas leaving no Oxygen in the altered exhaust gas, proper classification remains with this subclass.
- 551 Injecting from above and below melt surface:**
This subclass is indented under subclass 548. Process wherein the Oxygen gas or Oxygen gas containing gas composition is injected from both above and below the melt surface at the same time or at different times in the processing.
- (1) Note. Injection into the slag or slag-melt interface is considered to be from above

the melt surface for the purposes of classification in this subclass.

552 Including other gas from below:

This subclass is indented under subclass 551. Process wherein a gas other than Oxygen gas or an Oxygen gas containing gas composition is injected from below the melt surface at the same time or at a different time in the processing.

553 Injecting only from above melt surface:

This subclass is indented under subclass 548. Process wherein the Oxygen gas or the Oxygen gas containing gas composition is injected only from above the melt surface.

- (1) Note. Injection into the slag or slag-melt interface is considered to be from above the melt surface for purposes of classification in this subclass.

554 Including other gas from above:

This subclass is indented under subclass 553. Process wherein a gas other than Oxygen gas or an Oxygen gas containing gas composition is injected from above the melt surface at the same time or at a different time in the processing.

555 Including other gas from below:

This subclass is indented under subclass 553. Process wherein a gas other than Oxygen gas or an Oxygen gas containing gas composition is injected from below the melt surface at the same time or at a different time during the processing.

556 Injecting only from below melt surface:

This subclass is indented under subclass 548. Process wherein the Oxygen gas or Oxygen gas containing gas composition is injected only from below the melt surface.

557 Including other gas from below:

This subclass is indented under subclass 556. Process wherein a gas other than Oxygen gas or an Oxygen gas containing gas composition is injected from below the melt surface at the same time or at a different time during the processing.

558 Noble gas or inert gas not otherwise identified:

This subclass is indented under subclass 528. Process wherein a Noble gas (i.e., Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), or Xenon (Xe)) or an inert gas not otherwise identified is the injected gas.

- (1) Note. If the injected gas is named (i.e., Carbon dioxide), it is classified by the named gas even if the specification calls the gas inert.

559 Gas compound containing Oxygen (e.g., Carbon monoxide, Carbon dioxide, Water, etc.):

This subclass is indented under subclass 528. Process wherein the injected gas is a compound containing Oxygen (e.g., Carbon monoxide, Carbon dioxide, Water, etc.).

SEE OR SEARCH THIS CLASS, SUBCLASS:

540, or 548, for processes using gaseous compositions containing Oxygen gas such as air or Oxygen gas enriched gas compositions.

560 Treating premelted Iron (Fe) or slag layer thereon by adding solid agent, slag, or flux:

This subclass is indented under subclass 507. Process wherein premelted metal that contains over 50 percent by weight Iron (Fe) or slag layer thereon is contacted with a solid treating agent, a separately prepared slag, or flux.

- (1) Note. Classification is based on the agent, slag, or flux added to the molten metal or slag layer thereon and not on the composition of the in situ generated slag or solid agents initially present before melting or added during melting.

- (2) Note. The addition of molten metal to a solid agent, slag, or flux is acceptable to this subclass.

SEE OR SEARCH THIS CLASS, SUBCLASS:

571, for a process wherein a solid agent is utilized during the melting of a metal that contains over 50 percent by weight Iron (Fe).

561 Loose elemental Carbon (C), coal, or coke (e.g., carburizing, etc.):

This subclass is indented under subclass 560. Process wherein the solid agent added to the molten metal that contains over 50 percent by weight Iron (Fe) or slag layer thereon is loose elemental Carbon (C), coal, or coke.

- (1) Note. This subclass will take the use of loose Carbon, coal, or coke for carburizing but is not limited to carburizing.
- (2) Note. If the Carbon, coal, or coke is part of a consolidated composition containing other treating agents, classification goes elsewhere under subclass 560.

SEE OR SEARCH THIS CLASS, SUBCLASS:

532, for the use of elemental Carbon, coal, or coke in treating molten metal that contains over 50 percent by weight Iron or slag layer thereon in a process also utilizing a gas or liquid which gasifies.

536, 537, 542, 543, 566, or 567, for the use of a metal carbide or a high Carbon metal as a carburizing or treating agent.

562 Sulfur (S) or compound thereof:

This subclass is indented under subclass 560. Process wherein Sulfur (S) or a compound thereof is present in the solid agent, separately prepared slag, or flux.

563 Nitrate, Chlorate, Permanganate, or Peroxide:

This subclass is indented under subclass 560. Process wherein a Nitrate, Chlorate, Permanganate, or Peroxide is present in the solid agent, separately prepared slag, or flux.

564 Boron (B) or compound thereof:

This subclass is indented under subclass 560. Process wherein Boron (B) or a compound thereof is present in the solid agent, separately prepared slag, or flux.

565 Metal halide:

This subclass is indented under subclass 560. Process wherein a metal halide (e.g., Sodium chloride, Fluorspar, etc.) is present in the solid agent, separately prepared slag, or flux.

566 Carbide:

This subclass is indented under subclass 560. Process wherein a binary Carbon (C) compound of a metal (i.e., Carbide) is present in the solid agent, separately prepared slag, or flux.

567 Elemental metal or elemental Silicon (Si):

This subclass is indented under subclass 560. Process wherein elemental metal (e.g., scrap, Iron (Fe), Magnesium (Mg), Aluminum (Al), etc.) or elemental Silicon (Si) is present in the solid agent, separately prepared slag, or flux.

568 Aluminum (Al) or Magnesium (Mg):

This subclass is indented under subclass 567. Process wherein Aluminum (Al) or Magnesium (Mg) is the elemental metal.

569 Iron (Fe) containing compound:

This subclass is indented under subclass 560. Process wherein an Iron (Fe) containing compound (e.g., ore, scale, Iron oxide, etc.) is present in the solid agent, separately prepared slag, or flux.

570 Alkali metal compound or Alkaline earth metal compound:

This subclass is indented under subclass 560. Process wherein an Alkali metal compound (e.g., Sodium hydroxide, Sodium carbonate, etc.) or an Alkaline earth metal compound (e.g., Calcium Oxide, Calcium carbonate, etc.) is present in the solid agent, separately prepared slag, or flux.

571 Melting solid Iron (Fe):

This subclass is indented under subclass 507. Process wherein solid Iron (Fe) is employed in a process which includes the melting of the Iron.

572 Melting packaged Iron (Fe) or Iron of specified structure to facilitate melting (e.g., shaped bale of scrap, etc.):

This subclass is indented under subclass 571. Process wherein the solid Iron (Fe) which is melted is enclosed in or held together in a

package (e.g., steel can, wooden box, etc.) or in which the solid Iron is recited to have a particular shape or structure to facilitate melting.

SEE OR SEARCH CLASS:

428, Stock Material or Miscellaneous Articles, subclass 576 for a metallic article of particular shape to facilitate melting (e.g., package, etc.).

573 In shaft furnace (e.g., cupola, etc.):

This subclass is indented under subclass 571. Process wherein solid Iron (Fe) is melted in a vertical tubular furnace.

- (1) Note. In this subclass the charge is predominantly (i.e., over 50 percent) Iron in the metallic state. While there may be some reduction of Iron compound (e.g., rust or ore, etc.) taking place, the majority of the molten Iron produced exists in the metallic state when added to the furnace.

SEE OR SEARCH THIS CLASS, SUBCLASS:

488, for a process of reduction of an Iron compound in a shaft furnace. In this subclass over 50 percent of the Iron product is obtained by reduction of an Iron compound.

574 Without the use of solid, carbonaceous material (e.g., without coke, etc.):

This subclass is indented under subclass 573. Process wherein no solid, carbonaceous material (e.g., coke, etc.) is present in the shaft furnace during the melting process.

- (1) Note. Usually in this subclass the heat required to melt the Iron (Fe) is obtained by injecting a gaseous fuel with air through tuyeres on the bottom of the shaft furnace.

575 Using Oxygen in a higher concentration than ambient air:

This subclass is indented under subclass 573. Process wherein a gas that has a higher concentration of molecular Oxygen than ambient air is added to the shaft furnace at any place.

576 Using both a solid carbonaceous fuel (e.g., coke, etc.) and a fluid fuel (e.g., natural gas, etc.):

This subclass is indented under subclass 573. Process which employs a solid carbonaceous fuel (e.g., coke, etc.) and a fluid fuel (e.g., natural gas, etc.).

- (1) Note. The solid carbonaceous fuel is usually charged to the furnace along with the metal to be melted and the fluid fuel is injected through the tuyeres along with the combustion air.

577 Defined composition of solid fuel other than nominal "coke":

This subclass is indented under subclass 573. Process wherein the shaft furnace employs a solid fuel of defined composition other than nominal "coke".

- (1) Note. Any definition of the solid, carbonaceous fuel beyond mere nominal "coke" will be sufficient to classify a patent herein, such as defined particle size, strength of coke, anthracite coal, etc.

578 With Calcium carbide:

This subclass is indented under subclass 573. Process wherein Calcium carbide is present in the shaft furnace with the Iron (Fe) being melted.

579 With Alkali metal compound:

This subclass is indented under subclass 573. Process wherein an Alkali metal compound is present in the shaft furnace with the Iron (Fe) being melted.

580 In closed vessel with heat conducted through walls only (e.g., crucible melting, etc.):

This subclass is indented under subclass 571. Process in which the Iron (Fe) to be melted is placed in a vessel which is then closed with a lid so that no external materials such as combustion gasses can contact the Iron. The vessel is placed in a hot environment and the Iron is melted solely by heat conducted through the walls of the vessel.

- (1) Note. This is often called the crucible process.

581 Melting scrap:

This subclass is indented under subclass 571. Process wherein the solid Iron (Fe) melted is the waste from manufacturing or is obtained from articles which are no longer useful as such.

- (1) Note. The term “scrap” in a patent will make placement in this subclass proper.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 433, for a process of preheating scrap Iron to facilitate later melting without actually melting the scrap Iron.

582 Separating slag from molten Iron (Fe):

This subclass is indented under subclass 507. Process for separating slag from molten Iron (Fe) (e.g., by skimming, etc.).

583 Stirring or agitating molten Iron (Fe):

This subclass is indented under subclass 507. Process wherein molten Iron (Fe) is stirred either by contacting with a mechanical device (e.g., a stirring impeller, etc.) or without a separate mechanical device contacting the molten Iron (e.g., by shaking the container holding the molten Iron, etc.).

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 10.67, for a method of agitating molten Iron with a magnetic field.
528+, for a method of agitating molten Iron by injecting a gas.

584 Pouring or tapping molten Iron (Fe):

This subclass is indented under subclass 507. Process wherein molten Iron (Fe) is either poured or allowed to run from a vessel in which it is contained.

585 Nonferrous:

This subclass is indented under subclass 414. Process in which a metal other than Iron (Fe) is produced or a metal that contains over 50 percent by weight Nonferrous metal, singly or in combination, is treated.

SEE OR SEARCH CLASS:

- 420, Alloys or Metallic Compositions, for processes for making a Nonferrous alloy.

586 Concurrent production of Nonferrous metal and other desired nonmetallic product (e.g., cement, etc.):

This subclass is indented under subclass 585. Process in which a material is reduced to Nonferrous metal with simultaneous production of another product other than usual by-products (e.g., cement, etc.).

587 Countercurrent liquid-liquid extraction of molten Nonferrous metal:

This subclass is indented under subclass 585. Process in which a molten metal is introduced into a separating column and is flowed countercurrent to a contaminated metal that contains over 50 percent by weight Nonferrous metal to purify the contaminated metal.

588 Fractionation of molten Nonferrous metal (e.g., with reflux, etc.):

This subclass is indented under subclass 585. Process in which the molten metal that contains over 50 percent by weight Nonferrous metal is separated by separately collecting the distillates evaporating at certain temperatures.

589 Alkali metal, singly or in combination:

This subclass is indented under subclass 585. Process in which an Alkali metal (i.e., Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs)) is produced or a metal that contains over 50 percent by weight Alkali metal, singly or in combination, is treated.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 745, for a process of producing an Alkali metal or treating a metal that contains over 50 percent by weight Alkali metal, singly or in combination, below 300 degrees C.

590 Vaporizing or condensing:

This subclass is indented under subclass 589. Process in which the Alkali metal is vaporized or condensed. The vaporization can occur during the reduction of an Alkali metal compound.

- SEE OR SEARCH THIS CLASS, SUB-CLASS:
752, for a process in which a metal impurity is vaporized in a process including consolidation of a metalliferous material.
- 591 Cesium (Cs):**
This subclass is indented under subclass 590. Process in which Cesium (Cs) is vaporized or condensed.
- 592 Precipitating impurities from molten Alkali metal:**
This subclass is indented under subclass 589. Process in which the contaminants are settled out of a molten metal that contains over 50 percent by weight Alkali metal, singly or in combination.
- 593 Beryllium (Be):**
This subclass is indented under subclass 585. Process in which Beryllium (Be) is produced or a metal that contains over 50 percent by weight Beryllium is treated.
- 594 Magnesium (Mg):**
This subclass is indented under subclass 585. Process in which Magnesium (Mg) is produced or a metal that contains over 50 percent by weight Magnesium is treated.
- 595 Vaporizing or condensing:**
This subclass is indented under subclass 594. Process in which Magnesium (Mg) is vaporized or condensed.
- SEE OR SEARCH THIS CLASS, SUB-CLASS:
752, for a process in which a metal impurity is vaporized in a process including consolidation of a metalliferous material.
- 596 Reduction:**
This subclass is indented under subclass 595. Process in which a Magnesium (Mg) compound is reduced to metal.
- 597 Using metal or metal compound reductant:**
This subclass is indented under subclass 596. Process in which a Magnesium (Mg) compound is reduced by using a metal or a metal compound.
- 598 And Carbon (C):**
This subclass is indented under subclass 597. Process in which Carbon (C) is also used.
- 599 Using Carbon (C):**
This subclass is indented under subclass 596. Process in which a Magnesium (Mg) compound is reduced by using Carbon (C).
- 600 Treating molten Magnesium (Mg):**
This subclass is indented under subclass 594. Process in which a molten metal that contains over 50 percent by weight Magnesium (Mg) is treated.
- 601 Precipitating impurities from molten Magnesium (Mg):**
This subclass is indented under subclass 600. Process in which the contaminants are settled out of a molten metal that contains over 50 percent by weight Magnesium (Mg).
- 602 Adding gas:**
This subclass is indented under subclass 600. Process in which a gas is added to molten metal that contains over 50 percent by weight Magnesium (Mg).
- 603 And solid:**
This subclass is indented under subclass 602. Process in which a solid is added to molten metal that contains over 50 percent by weight Magnesium (Mg).
- 604 Adding solid:**
This subclass is indented under subclass 600. Process in which a solid is added to molten metal that contains over 50 percent by weight Magnesium (Mg).
- 605 Alkaline earth metal, singly or in combination:**
This subclass is indented under subclass 585. Process in which an Alkaline earth metal (i.e., Calcium (Ca), Strontium (Sr), Barium (Ba)) is produced or a metal that contains over 50 per-

- cent by weight Alkaline earth metal, singly or in combination, is treated.
- 606 Reducing halide:**
This subclass is indented under subclass 605. Process in which an Alkaline earth metal halide is reduced to metal.
- 607 Vaporizing or condensing:**
This subclass is indented under subclass 605. Process in which an Alkaline earth metal is vaporized or condensed.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
752, for a process in which a metal impurity is vaporized in a process including consolidation of a metalliferous material.
- 608 Reduction:**
This subclass is indented under subclass 607. Process in which an Alkaline earth metal compound is reduced metal.
- 609 Treating molten Alkaline earth metal:**
This subclass is indented under subclass 605. Process in which a molten metal that contains over 50 percent by weight Alkaline earth metal, singly or in combination, is treated.
- 610 Rare earth metal, singly or in combination:**
This subclass is indented under subclass 585. Process in which a Rare earth metal (i.e., Scandium (Sc), Yttrium (Y), Lanthanum (La), Cerium (Ce), Praseodymium (Pr), Neodymium (Nd), Samarium (Sm), Europium (Eu), Gadolinium (Gd), Terbium (Tb), Dysprosium (Dy), Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), Lutetium (Lu)) is produced or a metal that contains over 50 percent by weight Rare earth metal, singly or in combination, is treated.
- 611 Refractory metal, singly or in combination:**
This subclass is indented under subclass 585. Process in which a Refractory metal (i.e., Titanium (Ti), Zirconium (Zr), Hafnium (Hf), Vanadium (V), Niobium (Nb) or Columbium (Cb), Tantalum (Ta), Chromium (Cr), Molybdenum (Mo), or Tungsten (W)) is produced or a metal that contains over 50 percent by weight Refractory metal, singly or in combination, is treated.
- 612 Titanium (Ti), Zirconium (Zr), or Hafnium (Hf), singly or in combination:**
This subclass is indented under subclass 611. Process in which Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) is produced or a metal that contains over 50 percent by weight Titanium, Zirconium, or Hafnium, singly or in combination, is treated.
- 613 Reduction:**
This subclass is indented under subclass 612. Process in which a Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) compound is reduced to metal.
- 614 Using free metal or alloy reductant:**
This subclass is indented under subclass 613. Process in which the compound is reduced by using a free metal or alloy.
- 615 Of Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) compound containing Halogen:**
This subclass is indented under subclass 614. Process in which the Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) compound that is reduced contains Halogen.
- 616 Of binary halide - MX(4):**
This subclass is indented under subclass 615. Process in which the compound that is reduced is a binary halide - MX(4).
- 617 Of chloride - MCl (4):**
This subclass is indented under subclass 616. Process in which the compound that is reduced is a binary chloride - MCl (4).
- 618 Free metal or alloy reductant contains Magnesium (Mg):**
This subclass is indented under subclass 617. Process in which the compound is reduced by using a free metal or alloy reductant that contains Magnesium (Mg).
- 619 Metal produced is Titanium (Ti):**
This subclass is indented under subclass 618. Process in which the metal that is produced is Titanium (Ti).

- 620 Of Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) compound containing Halogen:**
This subclass is indented under subclass 613. Process in which the Titanium (Ti), Zirconium (Zr), or Hafnium (Hf) compound that is reduced contains Halogen.
- 621 Treating molten Titanium (Ti), Zirconium (Zr), or Hafnium (Hf):**
This subclass is indented under subclass 612. Process in which a molten metal that contains over 50 percent by weight Titanium (Ti), Zirconium (Zr), or Hafnium (Hf), singly or in combination, is treated.
- 622 Vanadium (V), Niobium (Nb) or Columbium (Cb), or Tantalum (Ta), singly or in combination:**
This subclass is indented under subclass 611. Process in which Vanadium (V), Niobium (Nb) or Columbium (Cb), or Tantalum (Ta) is produced or a metal that contains over 50 percent by weight Titanium, Niobium or Columbium, or Tantalum, singly or in combination, is treated.
- 623 Chromium (Cr), Molybdenum (Mo), or Tungsten (W), singly or in combination:**
This subclass is indented under subclass 611. Process in which Chromium (Cr), Molybdenum (Mo), or Tungsten (W) is produced or a metal that contains over 50 percent by weight Chromium, Molybdenum, or Tungsten, singly or in combination, is treated.
- 624 Manganese (Mn):**
This subclass is indented under subclass 585. Process in which Manganese (Mn) is produced or a metal that contains over 50 percent by weight Manganese is treated.
- 625 Reduction:**
This subclass is indented under subclass 624. Process in which a Manganese (Mn) compound is reduced to metal.
- 626 Cobalt (Co):**
This subclass is indented under subclass 585. Process in which Cobalt (Co) is produced or a metal that contains over 50 percent by weight Cobalt is treated.
- 627 Reduction:**
This subclass is indented under subclass 626. Process in which a Cobalt (Co) compound is reduced to metal.
- 628 Nickel (Ni):**
This subclass is indented under subclass 585. Process in which Nickel (Ni) is produced or a metal that contains over 50 percent by weight Nickel is treated.
- 629 Reduction:**
This subclass is indented under subclass 628. Process in which a Nickel (Ni) compound is reduced to metal.
- 630 Segregation process:**
This subclass is indented under subclass 629. Process in which a Nickel (Ni) compound is reduced to metal by reacting the compound with a mixture of a carbonaceous reductant and a chloridizing agent.
- 631 Noble metal, singly or in combination:**
This subclass is indented under subclass 585. Process in which a Noble metal (i.e., Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)) is produced or a metal that contains over 50 percent by weight Noble metal, singly or in combination, is treated.
- 632 Palladium (Pd):**
This subclass is indented under subclass 631. Process in which Palladium (Pd) is produced or a metal that contains over 50 percent by weight Palladium is treated.
- 633 Platinum (Pt):**
This subclass is indented under subclass 631. Process in which Platinum (Pt) is produced or a metal that contains over 50 percent by weight Platinum is treated.
- 634 Silver (Ag):**
This subclass is indented under subclass 631. Process in which Silver (Ag) is produced or a metal that contains over 50 percent by weight Silver is treated.

- 635 Recovering Silver (Ag) from photographic material:**
This subclass is indented under subclass 634. Process in which Silver (Ag) is obtained from photographic material.
- 636 Reduction:**
This subclass is indented under subclass 634. Process in which a Silver (Ag) compound is reduced to metal.
- 637 Gold (Au):**
This subclass is indented under subclass 631. Process in which Gold (Au) is produced or a metal that contains over 50 percent by weight Gold is treated.
- 638 Copper (Cu):**
This subclass is indented under subclass 585. Process in which Copper (Cu) is produced or a metal that contains over 50 percent by weight Copper is treated.
- 639 Treating material in gaseous suspension:**
This subclass is indented under subclass 638. Process in which a material undergoing treatment is in a highly dispersed state in a gaseous medium.
- 640 Treating slag or dross:**
This subclass is indented under subclass 638. Process in which a slag or dross is treated to produce Copper (Cu).
- 641 Reduction:**
This subclass is indented under subclass 638. Process in which a Copper (Cu) compound is reduced to metal.
- 642 Segregation process:**
This subclass is indented under subclass 641. Process in which a Copper (Cu) compound is reduced to metal by reacting the compound with a mixture of a carbonaceous reductant and a chloridizing agent.
- 643 Treating matte or sulfide:**
This subclass is indented under subclass 641. Process in which a Copper (Cu) matte or sulfide is treated to produce Copper.
- 644 Treating waste gas:**
This subclass is indented under subclass 643. Process in which the exhaust gas is treated.
- 645 With prior production of matte or sulfide:**
This subclass is indented under subclass 643. Process in which the Copper (Cu) matte or sulfide is formed before the matte or sulfide is treated to produce Copper.
- 646 Treating molten Copper (Cu):**
This subclass is indented under subclass 638. Process in which a molten metal that contains over 50 percent by weight Copper (Cu) is treated.
- 647 By vacuum:**
This subclass is indented under subclass 646. Process in which molten metal that contains over 50 percent by weight Copper (Cu) is subjected to sub-atmospheric pressures.
- 648 Adding gas:**
This subclass is indented under subclass 646. Process in which a gas is added to molten metal that contains over 50 percent by weight Copper (Cu).
- 649 Containing gaseous Oxygen:**
This subclass is indented under subclass 648. Process in which the gas contains gaseous oxygen.
- 650 And adding solid:**
This subclass is indented under subclass 649. Process in which a solid is added to molten metal that contains over 50 percent by weight Copper (Cu).
- 651 And solid:**
This subclass is indented under subclass 648. Process in which a solid is added to molten metal that contains over 50 percent by weight Copper (Cu).
- 652 Adding solid:**
This subclass is indented under subclass 646. Process in which a solid is added to molten metal that contains over 50 percent by weight Copper (Cu).

- 653 Melting Copper (Cu) in shaft furnace:**
This subclass is indented under subclass 638. Process in which metal that contains over 50 percent by weight Copper (Cu) is melted in a shaft furnace.
- 654 Zinc (Zn):**
This subclass is indented under subclass 585. Process in which Zinc (Zn) is produced or a metal that contains over 50 percent by weight Zinc is treated.
- 655 Treating slag or dross:**
This subclass is indented under subclass 654. Process in which a slag or dross is treated to produce Zinc (Zn).
- 656 Reduction:**
This subclass is indented under subclass 654. Process in which a Zinc (Zn) compound is reduced to metal.
- 657 Using Halogen containing material:**
This subclass is indented under subclass 656. Process in which a Zinc (Zn) compound is reduced by using a material containing Halogen.
- 658 Vaporizing or condensing:**
This subclass is indented under subclass 656. Process in which Zinc (Zn) is vaporized or condensed.

SEE OR SEARCH THIS CLASS, SUBCLASS:
752, for a process in which a metal impurity is vaporized in a process including consolidation of a metalliferous material.
- 659 Treating material in gaseous suspension:**
This subclass is indented under subclass 658. Process in which a material undergoing treatment is in a highly dispersed state in a gaseous medium.
- 660 Treating material in blast furnace or cupola:**
This subclass is indented under subclass 658. Process in which a blast furnace or cupola is used.
- 661 Treating material in vertical retort:**
This subclass is indented under subclass 658. Process in which a vertical retort is used.
- 662 Treating material in rotary kiln:**
This subclass is indented under subclass 658. Process in which a Zinc (Zn) compound is reduced in an approximately cylindrical vessel rotating on its cylindrical axis. The axis is horizontal or inclined less than 45 degrees from horizontal. The vessel rotates in only one direction through an angle of over 360 degrees during the reduction and rotates substantially continuously.
- 663 Treating molten or vaporous Zinc (Zn):**
This subclass is indented under subclass 654. Process in which a molten or vaporous metal that contains over 50 percent by weight Zinc (Zn) is treated.
- 664 Using Halogen containing material:**
This subclass is indented under subclass 663. Process in which a material that contains Halogen is used.
- 665 Vaporizing or condensing:**
This subclass is indented under subclass 663. Process in which Zinc (Zn) is vaporized or condensed.
- 666 Condensing with Lead (Pb) coolant:**
This subclass is indented under subclass 665. Process in which Lead (Pb) coolant is used to condense the vaporous Zinc (Zn).
- 667 Condensing with use of molten metal slinger:**
This subclass is indented under subclass 665. Process in which a device for centrifugally throwing liquid is used to hurl molten metal into vaporous Zinc (Zn) in order to condense the vaporous Zinc.
- 668 Cadmium (Cd):**
This subclass is indented under subclass 585. Process in which Cadmium (Cd) is produced or a metal that contains over 50 percent by weight Cadmium is treated.

- 669 Vaporizing or condensing:**
This subclass is indented under subclass 668. Process in which Cadmium (Cd) is vaporized or condensed.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
752, for a process in which a metal impurity is vaporized in a process including consolidation of a metalliferous material.
- 670 Mercury (Hg):**
This subclass is indented under subclass 585. Process in which Mercury (Hg) is produced or a metal that contains over 50 percent by weight Mercury is treated.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
388+, for a process in which an amalgam is broken to produce free metal.
- 671 Aluminum (Al):**
This subclass is indented under subclass 585. Process in which Aluminum (Al) is produced or a metal that contains over 50 percent by weight Aluminum is treated.
- 672 Treating slag or dross:**
This subclass is indented under subclass 671. Process in which a slag or dross is treated to produce Aluminum (Al).
- 673 Reduction:**
This subclass is indented under subclass 671. Process in which an Aluminum (Al) compound is reduced to metal.
- 674 Carbothermic:**
This subclass is indented under subclass 673. Process in which an Aluminum (Al) compound is reduced in the presence of a carbonaceous material, Carbon (C) or carbide.
- 675 Decomposition of organo-compound containing Aluminum (Al):**
This subclass is indented under subclass 673. Process in which an organo-compound containing Aluminum (Al) is reduced.
- 676 Of Aluminum (Al) halide:**
This subclass is indented under subclass 673. Process in which an Aluminum (Al) compound containing Halogen is reduced.
- 677 Of subhalide:**
This subclass is indented under subclass 676. Process in which the compound is an Aluminum (Al) monohalide.
- 678 Treating molten Aluminum (Al):**
This subclass is indented under subclass 671. Process in which a molten metal that contains over 50 percent by weight Aluminum (Al) is treated.
- 679 Fractional crystallization:**
This subclass is indented under subclass 678. Process in which molten metal that contains over 50 percent by weight Aluminum (Al) is preferentially crystallized in order to obtain purified metal. The impurities are excluded from the purified crystals that form.
- SEE OR SEARCH CLASS:
156, Adhesive Bonding and Miscellaneous Chemical Manufacture, subclasses 600+ for processes directed to the formation of a single crystal.
- 680 Adding gas:**
This subclass is indented under subclass 678. Process in which a gas is added to molten metal that contains over 50 percent by weight Aluminum (Al).
- 681 Containing Halogen atom:**
This subclass is indented under subclass 680. Process in which the gas contains Halogen.
- 682 And adding solid:**
This subclass is indented under subclass 681. Process in which a solid is added to molten metal that contains over 50 percent by weight Aluminum (Al).
- 683 And solid:**
This subclass is indented under subclass 680. Process in which a solid is added to molten metal that contains over 50 percent by weight Aluminum (Al).

- 684 Adding solid:**
This subclass is indented under subclass 678. Process in which a solid is added to molten metal that contains over 50 percent by weight Aluminum (Al).
- 685 Containing Halogen:**
This subclass is indented under subclass 684. Process in which the solid contains Halogen.
- 686 Melting Aluminum (Al):**
This subclass is indented under subclass 671. Process in which metal that contains over 50 percent by weight Aluminum (Al) is melted.
- 687 Scrap:**
This subclass is indented under subclass 686. Process in which metal scrap that contains over 50 percent by weight Aluminum (Al) is melted.
- 688 Gallium (Ga) or Indium (In):**
This subclass is indented under subclass 585. Process in which Gallium (Ga) or Indium (In) is produced or a metal that contains over 50 percent by weight Gallium or over 50 percent by weight Indium is treated.
- 689 Germanium (Ge):**
This subclass is indented under subclass 585. Process in which Germanium (Ge) is produced or a metal that contains over 50 percent by weight Germanium is treated.
- 690 Tin (Sn):**
This subclass is indented under subclass 585. Process in which Tin (Sn) is produced or a metal that contains over 50 percent by weight Tin is treated.
- 691 Reduction:**
This subclass is indented under subclass 690. Process in which a Tin (Sn) compound is reduced to metal.
- 692 Of Halogen containing material:**
This subclass is indented under subclass 691. Process in which a Tin (Sn) compound containing a Halogen is reduced.
- 693 Lead (Pb):**
This subclass is indented under subclass 585. Process in which Lead (Pb) is produced or a metal that contains over 50 percent by weight Lead is treated.
- 694 Treating material in gaseous suspension or gaseous state:**
This subclass is indented under subclass 693. Process in which a material undergoing treatment is in a highly dispersed state in a gaseous medium or is in a gaseous state.
- 695 Reduction:**
This subclass is indented under subclass 693. Process in which a Lead (Pb) compound is reduced to metal.
- 696 Of Lead-Sulfur compound:**
This subclass is indented under subclass 695. Process in which the Lead (Pb) compound contains Sulfur (S).
- 697 Treating molten Lead (Pb):**
This subclass is indented under subclass 693. Process in which a molten metal that contains over 50 percent by weight Lead (Pb) is treated.
- 698 By vacuum:**
This subclass is indented under subclass 697. Process in which molten metal that contains over 50 percent by weight Lead (Pb) is subjected to sub-atmospheric pressures.
- 699 Adding gas:**
This subclass is indented under subclass 697. Process in which a gas is added to molten metal that contains over 50 percent by weight Lead (Pb).
- 700 Containing Halogen atom:**
This subclass is indented under subclass 699. Process in which the gas contains Halogen.
- 701 Adding solid:**
This subclass is indented under subclass 697. Process in which a solid is added to molten metal that contains over 50 percent by weight Lead (Pb).

702 Containing free metal:

This subclass is indented under subclass 701. Process in which the solid contains a free metal.

703 Antimony (Sb):

This subclass is indented under subclass 585. Process in which Antimony (Sb) is produced or a metal that contains over 50 percent by weight Antimony is treated.

704 Reduction:

This subclass is indented under subclass 703. Process in which an Antimony (Sb) compound is reduced to metal.

705 Bismuth(Bi):

This subclass is indented under subclass 585. Process in which Bismuth is produced or a metal that contains over 50 percent by weight Bismuth is treated.

706 Arsenic (As):

This subclass is indented under subclass 585. Process in which Arsenic (As) is produced or a metal that contains over 50 percent by weight Arsenic is treated.

707 Reducing or smelting unnamed ore:

This subclass is indented under subclass 414. Process wherein an unnamed ore is reduced or smelted.

708 Stirring or agitating of molten material:

This subclass is indented under subclass 414. Process wherein molten material is subjected to an outside force to cause stirring or agitating of the material. This force may be applied by a mechanical stirrer, introduction of a gas, or movement of the vessel in which the material is held.

- (1) Note. The stirring or agitating caused by material being poured into or out of a container will not be sufficient for placement hereunder.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 10.67, for processes of stirring with a magnetic field.

709 Covering the surface of molten metal:

This subclass is indented under subclass 414. Process wherein the surface of molten metal is covered by a material to prevent contact with the ambient atmosphere.

- (1) Note. A container in which the metal is held will be ignored as far as placement hereunder is concerned.

710 Below 300 degrees C:

This subclass is indented under subclass 392. Process in which all stages of the process operate at a temperature below 300 degrees C (i.e., 572 degrees F).

- (1) Note. If a nonmetallic material which is liquid under standard conditions is used in a step of the process, the step will be assumed to occur at a temperature below 300 degrees C unless otherwise stated.

711 Using nonmetallic material which is liquid under standard conditions (e.g., hydrometallurgy, etc.):

This subclass is indented under subclass 710. Process wherein a nonmetallic material which is a liquid under standard conditions is used at any stage in the production of free metal.

- (1) Note. The use of a microorganism during the production of free metal is proper for Class 75.

SEE OR SEARCH THIS CLASS, SUB-CLASS:

- 343+, for processes utilizing a nonmetallic liquid to produce or to treat free metal in powder form.
416+, for processes at 300 degrees C or greater combined with a step utilizing a nonmetallic liquid.

SEE OR SEARCH CLASS:

- 134, Cleaning and Liquid Contact With Solids, for cleaning and liquid contact of metalliferous materials, per se.

- (1) Note. Any process recovering free metal from the contacting liquid or from the metal substrate by chemical reduction belongs in Class 75 even though cleaning is involved.

- 204, Chemistry: Electrical and Wave Energy, for electrical and wave energy processes and apparatus. Patents including a claim or claims classifiable in Class 204 and equally classifiable in Class 75 are classified as originals in Class 75 and cross-referenced to Class 204. In a claim containing both Class 204 and Class 75 operations, the patent is placed as an original in Class 75 if, in a branch of the process, it is essential to perform the Class 204 operation before the Class 75 free metal separation. If, however, in a branch of the process, it is essential to perform the Class 75 free metal separation before the Class 204 operation, the original is placed in Class 204 and crossed to Class 75. The measurement of electrical potential (i.e., millivolts) is not sufficient to take a Class 75 process to Class 204 as an original. See the Class 204 definition. Lines With Other Classes and Within This Class, Line Between Class 204 and Class 75, and References to Other Classes sections for an expansion of the class line between Class 75 and Class 204, including a superiority listing of classes providing for various metals, alloys, and metal stocks and methods of manufacturing them.
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, appropriate subclasses for electrolytic treatment, especially 334-639 for electrolytic synthesis in general, subclasses 557-559 for electrolytic preparation of a metal alloy, and subclasses 560-614 for electrolytic preparation of free metal.
- 210, Liquid Purification or Separation, for processes of removing metal ions from solution to purify the liquid. However, processes that produce a free metal go to Class 75 as original and are crossed to Class 210 if purification of a liquid is involved.
- 423, Chemistry of Inorganic Compounds, for chemical processes of treating metalliferous material to obtain a metal containing compound, processes that involve production of metal compounds or extracting, leaching or dissolving processes utilizing chemical treatment which do not produce free metal.
- (1) Note. Patents including claims classifiable in Class 423 and equally comprehensive claims classifiable in Class 75 are classified as original in Class 75 and cross-referenced to Class 423.
- (2) Note. Hydrometallurgical processes recovering metal values go to Class 423. However, if it can be determined conclusively that free (i.e., zero valent) metal is the metal value obtained, the patent is placed in Class 75.
- 427, Coating Processes, for processes of coating metal onto metallic substrates wherein the intention is to manufacture a coated product per se. However, if the intention is recovery of free metal by electromotive displacement wherein the metallic substrate dissolves as the free metal precipitates onto the substrate, proper classification goes to Class 75 even if a coated product is involved.
- 435, Chemistry: Molecular Biology and Microbiology, for processes employing a microorganism that do not involve the production of free metal.
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for processes of making or regenerating a metal catalyst such as by utilizing a liquid wherein the metal is specifically structured to catalyze a reaction or sorb a component (e.g., Raney nickel, etc.).
- 712 Involving mining or in situ operation:**
This subclass is indented under subclass 711. Process which involves operations at a mine or in situ location of the metalliferous material.
- SEE OR SEARCH CLASS:**
- 299, Mining or In Situ Disintegration of Hard Material, for processes involving mining or in situ operation that do

not utilize chemical reduction to the free metal state.

713 From photography material:

This subclass is indented under subclass 711. Process wherein the free metal is recovered from photography materials or developing solutions.

SEE OR SEARCH CLASS:

430, Radiation Imagery Chemistry: Process, Composition, or Product Thereof, particularly subclasses 398+, for processes of regenerating processing compositions. If a regenerated processing composition is the intended result, the original goes to Class 430 with a mandatory cross to Class 75 if free metal (e.g., Silver (Ag), etc.) is also recovered.

714 From electrolytic or cementation slime:

This subclass is indented under subclass 711. Process that produces free metal from a starting material which is a residue or mixture of metal-liferous materials from an electrolytic or displacement operation.

715 Removing coating to recover free metal from substrate or coating:

This subclass is indented under subclass 711. Process wherein a coating is removed from a substrate and free metal is recovered from either the substrate or coating.

SEE OR SEARCH CLASS:

134, Cleaning and Liquid Contact With Solids, for cleaning of metallic materials, per se. If a free metal is recovered from a cleaning solution, the original goes to Class 75 with a mandatory cross to Class 134 for cleaning. If the scrap or waste product is treated to recover a free metal substrate, the original goes to Class 75.

216, Etching a Substrate: Processes, for etching processes.

252, Compositions, subclasses 79.1 through 79.5 for etching or brightening compositions or subclass 364 for solvent compositions useful for leaching or dissolving metal substrates.

510, Cleaning Compositions for Solid Surfaces, Auxiliary Compositions There-

for, or Processes of Preparing the Compositions, appropriate subclasses for compositions designed to clean specialized metallic articles or bare metal substrates, per se.

521, Synthetic Resins or Natural Rubbers, for processes of treating scrap or waste to recover a solid polymer therefrom. If free metal is recovered, the original goes to Class 75 with a mandatory cross to Class 521 if the solid polymer is also recovered.

716 From Tin (Sn) scrap or Tin plate:

This subclass is indented under subclass 715. Process wherein the coating is removed from Tin (Sn) scrap or Tin plate.

(1) Note. A "detinning" process recovering and identifying a free metal substrate or recovering Tin as the free metal is placed in Class 75 as an original. However, if there is no identification of recovered free metal substrate and a tin compound is produced or recovered without recovery of tin as a free metal, placement goes to Class 423 as original.

717 Reducing to free metal with gas:

This subclass is indented under subclass 711. Process wherein a gas (e.g., Hydrogen, Sulfur dioxide, Carbon monoxide, hydrocarbon, etc.) is used to reduce a metalliferous material to free metal.

(1) Note. Partial reduction with a reducing gas from one ionic form to another is not sufficient for placement here. Free metal must be formed as a result of the gaseous treatment for this subclass.

718 Copper (Cu) recovered as free metal:

This subclass is indented under subclass 717. Process wherein the free metal produced is Copper (Cu).

719 Using Sulfur dioxide:

This subclass is indented under subclass 718. Process wherein Sulfur dioxide is the gas.

720 Noble metal recovered as free metal:

This subclass is indented under subclass 717. Process wherein the free metal recovered is a Noble metal (i.e., Ruthenium (Ru), Rhodium

- (Rh), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)).
- 721 Utilizing organic reducing agent:**
This subclass is indented under subclass 711. Process wherein an organic compound is used as a reducing agent for producing free metal.
- 722 Involving organic compound containing metal or organic agent for agglomerating metal:**
This subclass is indented under subclass 711. Process wherein an organic compound containing a metal (e.g., complex, solvent, resin, etc.) is involved at any stage in the process or process wherein an organic agent for agglomerating free metal (e.g., collecting agent, flocculation agent, flotation agent, etc.) is involved.
- (1) Note. Processes treating metalliferous materials and producing or recovering organo-metallic complexes without free metal production should be placed in the appropriate Organic Chemistry Class. However, if a free metal is produced, proper classification is in Class 75.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
413, for production of free metal from metal carbonyls or Carbon monoxide metallic complexes.
- SEE OR SEARCH CLASS:
534, Organic Compounds, subclasses 10+ for organic compounds containing radioactive metals and processes of producing same and subclasses 15+ for organic compounds containing rare earth metals and processes of producing same.
556, Organic Compounds, subclasses 1+ for organic compounds containing heavy metals and processes of producing same.
- 723 Natural or synthetic polymer:**
This subclass is indented under subclass 722. Process wherein the organic compound is a natural or synthetic polymer (e.g., resin, protein, etc.).
- 724 Displacing by another metal (i.e., electromotive series):**
This subclass is indented under subclass 711. Process wherein a more electropositive free metal displaces a less electropositive metal from solution in a free metal form, while the more electropositive metal goes into solution in ionic form.
- (1) Note. This process is sometimes referred to as cementation.
- (2) Note. Electrowinning will be considered to mean separation of metals by electrolysis proper for Class 205 unless otherwise indicated. A few patents use the term electrowinning to refer to displacement and when indicated proper classification is in Class 75.
- SEE OR SEARCH CLASS:
205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, subclasses 334+ or 687+, as appropriate, for electrowinning or separation of metals by electrolysis.
- 725 Lead (Pb) or Zinc (Zn) recovered as free metal:**
This subclass is indented under subclass 724. Process wherein the free metal recovered by displacement is Lead (Pb) or Zinc (Zn).
- 726 Copper (Cu) recovered as free metal:**
This subclass is indented under subclass 724. Process wherein the free metal recovered by displacement is Copper (Cu).
- 727 And flotation:**
This subclass is indented under subclass 726. Process wherein flotation in liquid is involved as a means of separating solid material from other solid material or from the liquid and free copper metal is produced at any stage of the process.
- 728 And injecting or pressurizing with air or Oxygen:**
This subclass is indented under subclass 726. Process wherein air or Oxygen is injected into the liquid or process wherein the liquid is sub-

- jected to treatment with air or Oxygen at pressures exceeding atmospheric pressure.
- 729 From Cyanide solution:**
This subclass is indented under subclass 726. Process wherein the Copper (Cu) free metal is precipitated from a Cyanide containing solution thereof.
- 730 With agitating or abrading:**
This subclass is indented under subclass 726. Process wherein an agitating or abrading action is performed with the liquid or on the solid metalliferous material.
- 731 Utilizing leaching agent containing Sulfur (S):**
This subclass is indented under subclass 726. Process which utilizes a Sulfur (S) containing chemical agent to leach the metalliferous material.
- 732 Noble metal recovered as free metal:**
This subclass is indented under subclass 724. Process wherein the free metal recovered by displacement is a Noble metal (i.e., Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)).
- 733 Silver (Ag) recovered as free metal:**
This subclass is indented under subclass 732. Process wherein the free metal recovered by displacement is Silver (Ag).
- 734 And injecting or pressurizing with air or Oxygen:**
This subclass is indented under subclass 733. Process wherein air or Oxygen is injected into the liquid or process wherein the liquid is subjected to treatment with air or Oxygen at pressures exceeding atmospheric pressure.
- 735 From Cyanide solution:**
This subclass is indented under subclass 733. Process wherein the Silver (Ag) free metal is precipitated from a Cyanide containing solution thereof.
- 736 Gold (Au) recovered as free metal:**
This subclass is indented under subclass 732. Process wherein the free metal recovered by displacement is Gold (Au).
- 737 From Cyanide solution:**
This subclass is indented under subclass 736. Process wherein the Gold (Au) free metal is precipitated from a Cyanide containing solution thereof.
- 738 Nickel (Ni) or Cobalt (Co) recovered as free metal:**
This subclass is indented under subclass 724. Process wherein the free metal recovered by displacement is Nickel (Ni) or Cobalt (Co).
- 739 Utilizing chemical agent to precipitate free metal:**
This subclass is indented under subclass 711. Process wherein precipitation of free metal occurs when a chemical agent is added to the metalliferous material.
- 740 Copper (Cu) recovered as free metal:**
This subclass is indented under subclass 739. Process wherein the free metal recovered is Copper (Cu).
- 741 Noble metal recovered as free metal:**
This subclass is indented under subclass 739. Process wherein the free metal recovered is a Noble metal (i.e., Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)).
- 742 Cleaning, leaching or dissolving of Mercury (Hg):**
This subclass is indented under subclass 711. Process wherein Mercury (Hg) is subjected to cleaning, leaching or dissolving to provide a refined Mercury.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
388, for preparing for amalgamation, preparing and amalgamating, or breaking an amalgam to produce free metal (e.g., Mercury).
- 743 With leaching or dissolving:**
This subclass is indented under subclass 711. Process wherein treatment of metalliferous material involves a leaching or dissolving operation at any stage in the production of free metal.

744 Noble metal recovered as free metal:

This subclass is indented under subclass 743. Process wherein the free metal recovered is a Noble metal (i.e., Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Osmium (Os), Iridium (Ir), Platinum (Pt), Silver (Ag), Gold (Au)).

745 Alkali metal, singly or in combination:

This subclass is indented under subclass 710. Process in which an Alkali metal (i.e., Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Cesium (Cs)) is produced or a metal that contains over 50 percent by weight Alkali metal, singly or in combination, is treated.

746 Consolidating metalliferous material (e.g., ore, tailings, flue dust, fluxes, etc.) by agglomerating, compacting, or heat treating; preparatory process therefor; or treating consolidated material therefrom:

This subclass is indented under subclass 330. Process for consolidating a metalliferous material (e.g., ore, tailings, flue dust, fluxes, etc.) to concentrate a desired metalliferous component or to perfect the metalliferous material for a metallurgical operation by compacting, agglomerating, or heat treatment; preparatory process therefor; or treatment of consolidated metalliferous material prepared thereby - wherein (1) there is no chemical production of free metal that remains in the product and (2) the product is amenable to a Class 75 or Class 420 refining or alloying operation.

- (1) Note. Consolidating of metalliferous material which is an ore may involve beneficiation. Beneficiation processes not involving consolidation of metalliferous materials will be found in other classes indicated in the following search notes if no free metal is in the product or elsewhere in this class if free metal is produced and present in the product.
- (2) Note. These subclasses 746+ will be considered the residual location taking combination of processes involving such consolidation and other process classes even when further Class 75 or Class 420 metallurgical operation is not expressed in the specification.

(3) Note. If the product of the process contains a free metal chemically produced by the process, classification goes to the above process subclasses even if consolidation is involved or even if only small amounts of free metal are produced that remain in the final product.

(4) Note. However, if undesirable materials are removed as free metal during the aforescribed consolidation process, classification remains in this section of Class 75.

(5) Note. If consolidation of the type hereinabove set forth without free metal production takes place at any stage of the process, classification remains in this section of Class 75 even if the final product is not a consolidated product. However, the final product must be in intermediate form amenable to Class 75 or 420 refining or alloying.

SEE OR SEARCH THIS CLASS, SUBCLASS:

303+, for charge or solid treating compositions for treating molten metal and particularly subclasses 310, 311 and 313+ for consolidated compositions.

SEE OR SEARCH CLASS:

23, Chemistry: Physical Processes, subclass 313 for agglomerating finely divided nonmetallic elements or inorganic compounds by treatments which cause coalescence of the particles and which involve only physical processes not specifically provided for in some other class.

34, Drying and Gas or Vapor Contact With Solids, for processes of drying ore or metalliferous material. However, if consolidation of the type hereinabove set forth is combined with drying and gas or vapor contact with solids, proper classification goes to Class 75.

65, Glass Manufacturing, for processes of making glass by fusing metalliferous materials.

106, Compositions: Coatings or Plastic, for processes of preparing molding,

- hydrosetting, filler, aggregate or pigment compositions containing metalliferous materials.
- 134, Cleaning and Liquid Contact With Solids, for cleaning and liquid contact of metalliferous materials, per se. However, cleaning or liquid contact involving consolidated metalliferous material as hereinabove set forth is proper for Class 75 if a chemical step is involved.
- 201, Distillation: Processes, Thermolytic, for thermolytic processes, not elsewhere provided, for treating carbonaceous material to produce coke or when it is uncertain that the process involves consolidation or treating of a consolidated metalliferous material as hereinabove set forth. If coking of a consolidated metalliferous composition is involved, it goes to this section of Class 75, unless it can be determined that free metal is produced.
- 205, Electrolysis: Processes, Compositions Used Therein, and Methods of Preparing the Compositions, for electrolytic processes of treating metalliferous material. Combinations of electrolysis and consolidation as hereinabove described are placed as original in Class 75 and crossed to Class 205.
- 209, Classifying, Separating, and Assorting Solids, for concentration processes which involve the separation of ore or metalliferous materials by nonchemical means (e.g., flotation, screening, amalgamation). However, if consolidation of the type set forth hereinabove is combined with the classifying, separating and assorting of solids, proper classification goes to Class 75.
- 210, Liquid Purification or Separation, for processes of separating a component from a liquid. If consolidation of metalliferous material of the type hereinabove set forth is involved at any stage of the process, proper classification goes to Class 75 even if liquid purification is involved and a cross-reference is placed in Class 210.
- 241, Solid Material Comminution or Disintegration, for processes of disintegrating ore or metalliferous material for the purpose of reducing particle size. Particularly see subclasses 3+ in Class 241. Combination of comminution or disintegration and Class 209 separation go to Class 241. Combination of comminution or disintegration with consolidation as hereinabove set forth go to Class 75 whether or not Class 209 separation is involved unless an intended use divergent from a Class 75 or 420 refining or alloying operation is expressed.
- 252, Compositions, for processes, not elsewhere provided, of making magnetic or chemical treating compositions containing metalliferous materials.
- 264, Plastic and Nonmetallic Article Shaping or Treating: Processes, particularly subclasses 109+ for uniting of bulk assembly particulate materials and for methods of compacting and briquetting nonmetallic particles intended for uses other than Class 75 or Class 420 refining or alloying. However, processes preparing consolidated metalliferous charges or metalliferous treating agents amenable to Class 75 or Class 420 refining or alloying operation go as original to this section of Class 75.
- 419, Powder Metallurgy Processes, for producing metals, alloys or metal containing compositions in a solid or compact state from powdered or particulate material with or without heating. If a consolidated metalliferous composition is intended for Class 75 or 420 refining or alloying operation, proper classification of the process of consolidation goes to Class 75. The consolidation of free metal containing flue dust or inclusion of a free metal reactant (i.e., powdered aluminum) in a compacted metalliferous product intended for Class 75 or 420 refining or alloying goes to this section of Class 75. Here the line is strictly one of intent.
- 423, Chemistry of Inorganic Compounds, for chemical processes of beneficiating ore or metalliferous material that

provide intermediate products even if intended for a Class 75 or Class 420 operation. However, if the chemical process includes a step of consolidation of the type hereinbefore set forth, classification goes to Class 75.

- (1) Note. Patents including claims classifiable in Class 423 and equally comprehensive claims classifiable in Class 75 are classified in Class 75 and cross-referenced to Class 423.
- (2) Note. If a free metal is produced, classification goes to Class 75 or if an alloy is produced to Class 420 even when chemical steps are involved. If the free metal produced by the chemical process ends up in the product as a free metal, proper classification is in the above free metal section of Class 75 and not in this consolidation section of Class 75.
- (3) Note. Processes of roasting or treating iron oxide ores to change oxidation state without free metal production go to Class 423. However, if consolidation is also involved as set forth hereinabove, classification goes to this section of Class 75.
- (4) Note. Hydrometallurgical processes not producing free metal go to Class 423. However, if consolidation of the type hereinabove set forth is involved, proper classification goes to Class 75.
- (5) Note. Processes of removing an impurity from an ore (e.g., roasting, desulfurizing, dephosphorizing, or dearsenizing, etc.) are classified in Class 423, subclasses 1+ based upon the metal values recovered. If no particular resulting metal value is disclosed classification is in Class 423 subclass 1. However, if consolidation as hereinbefore set forth is involved, classification is in Class 75.

- 427, Coating Processes, for processes of coating ore or metalliferous material. However, if consolidation of the type hereinabove set forth is present, classification goes to Class 75, even if a coated product is produced.
- 501, Compositions: Ceramic, for processes of producing ceramic, glass, or refractory compositions that contain fused or sintered metalliferous materials.
- 502, Catalyst, Solid Sorbent, or Support Therefor: Product or Process of Making, for processes of producing metalliferous products intended for use as a catalyst or sorbent. If the consolidated metalliferous material as hereinabove set forth is intended for use as a catalyst or sorbent, the original goes to Class 502.
- 507, Earth Boring, Well Treating, and Oil Field Chemistry, for well treating compositions containing metalliferous materials.

747 Noble metal containing metalliferous material:

This subclass is indented under subclass 746. Process involving consolidation of Noble metal containing metalliferous material without chemical production of free Noble metal that remains in the product.

SEE OR SEARCH THIS CLASS, SUBCLASS:

- 388, for amalgamation processes.
- 631+, for processes of chemically reducing Noble metal containing metalliferous materials to the zero valent state.

748 With vaporization of impurity as metal halide:

This subclass is indented under subclass 746. Process wherein an undesirable component is removed by reacting the ore or metalliferous material with a halogenating agent (e.g., Sodium chloride, Hydrochloric acid, Chlorine, Fluorine, etc.) and the resulting metal halide is vaporized.

- 749 With physical separation or classification of solids:**
This subclass is indented under subclass 746. Combined process that involves separating solid materials and assorting or segregating them into grades or classes according to physical characteristics (e.g., flotation, screening, flocculation, etc.) of solids.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
746, for the line between Class 209 and Class 75 and for combined operations acceptable to Class 75.
- 750 By sifting:**
This subclass is indented under subclass 749. Process that includes a sifting (e.g., screening, etc.) operation to separate or classify solid material.
- 751 With heat treatment (e.g., calcinating, fusing, indurating, roasting, sintering, vaporizing, etc.):**
This subclass is indented under subclass 746. Process which includes heat treatment (e.g., calcinating, fusing, indurating, roasting, sintering, vaporizing, etc.) that may occur before, after, or during consolidation.
- 752 Vaporizing metalliferous impurity:**
This subclass is indented under subclass 751. Process involving the removal of undesirable metalliferous material by vaporization thereof.
- (1) Note. If the vaporization of elemental or free metal is involved, the subject matter is placed here only if the metal is considered an impurity. Otherwise, the subject matter is classified in the above refining, or purifying subclasses for free metal production or Class 420 for alloy production.
- (2) Note. Following precedent, Arsenic (As) is considered a metal for purposes of classification in this subclass.
- SEE OR SEARCH THIS CLASS, SUBCLASS:
748, for vaporization of impurity as a metal halide.
- 753 With leaching, dissolving, or washing:**
This subclass is indented under subclass 751. Process wherein the consolidated metalliferous material or the material undergoing consolidation is subjected to a leaching, dissolving, or washing treatment.
- 754 By suspension (e.g., fluid bed, cyclone, etc.):**
This subclass is indented under subclass 751. Process wherein the consolidated metalliferous material or the material undergoing consolidation is heat treated in the suspended state (e.g., fluid bed, cyclone, etc.).
- 755 On moving grate, moving pallet, or endless belt:**
This subclass is indented under subclass 751. Process wherein the consolidated metalliferous material or the material undergoing consolidation is heat treated on a moving grate, moving pallet, or endless belt (e.g., Dwight-Loyd, Greenawalt apparatus, etc.).
- 756 Using multi-layers:**
This subclass is indented under subclass 755. Process wherein the material undergoing heat treatment is placed on the grate, pallet, or belt in more than one layer defined by particle characteristics or interspersed with a layer of diverse material (e.g., fuel, etc.).
- (1) Note. The multi-layers do not refer to coatings on a pellet, briquette, or consolidated material but refer solely to the layering of materials undergoing treatment on the moving apparatus.
- 757 With gas recycling for reusing:**
This subclass is indented under subclass 755. Process wherein gas used or produced in the heat treatment is recycled or reused in the same heat treatment process or in a diverse operation.
- 758 Sintering:**
This subclass is indented under subclass 755. Process wherein the consolidated metalliferous material or the material undergoing consolidation is sintered by the heat treatment.

759 Of consolidated starting material:

This subclass is indented under subclass 758. Process wherein the metalliferous material is consolidated (e.g., agglomerated, compacted, indurated, or presintered, etc.) prior to the instant sintering.

760 In shaft furnace or multi-hearth furnace:

This subclass is indented under subclass 751. Process wherein the consolidated metalliferous material or the material undergoing consolidation is heat treated in an upright cylindrical furnace known as a shaft furnace or in any furnace containing multiple hearths.

761 Sintering:

This subclass is indented under subclass 760. Process wherein the consolidated metalliferous material or the material undergoing consolidation is sintered by the heat treatment.

762 In rotary kiln:

This subclass is indented under subclass 751. Process wherein the consolidated metalliferous material of the material undergoing consolidation is heat treated and agitated at any process stage by a chamber or converter that rotates 360 degrees.

763 Sintering:

This subclass is indented under subclass 762. Process wherein the consolidated metalliferous material or the material undergoing consolidation is sintered by the heat treatment.

764 Coking of binder or additive:

This subclass is indented under subclass 751. Process wherein a carbonaceous binder or additive is subjected to an in situ destructive distillation producing a consolidated metalliferous material containing or coated with coke.

765 Sintering or with agglomerating or compacting:

This subclass is indented under subclass 751. Process wherein sintering or heat treatment of agglomerated or compacted metalliferous material is involved.

766 With coal, coke, pitch, asphalt, or tar:

This subclass is indented under subclass 765. Process wherein coal, coke, pitch, asphalt, or tar is incorporated in or coated on the consoli-

dated material or utilized as a fuel with the material undergoing consolidation.

767 With synthetic polymer, natural polymer, or carbohydrate:

This subclass is indented under subclass 765. Process wherein a synthetic polymer, natural polymer, or carbohydrate is incorporated in or coated on the consolidated material or utilized as a fuel with the material undergoing consolidation.

768 With Alkaline earth metal compound, clay, or hydrosetting agent:

This subclass is indented under subclass 765. Process wherein an Alkaline earth metal compound, clay, or hydrosetting agent (e.g., cement, etc.) is incorporated in or coated on the consolidated material.

769 Sintering:

This subclass is indented under subclass 765. Process wherein the metalliferous material is sintered.

770 Agglomerating or compacting:

This subclass is indented under subclass 746. Process wherein agglomerating or compacting or treatment of agglomerated or compacted metalliferous material is involved.

771 With coal, coke, pitch, asphalt, or tar:

This subclass is indented under subclass 770. Process wherein coal, coke, pitch, asphalt, or tar is incorporated in or coated on the consolidated material.

772 With synthetic polymer, natural polymer, or carbohydrate:

This subclass is indented under subclass 770. Process wherein synthetic polymer, natural polymer, or carbohydrate is incorporated in or coated on the consolidated material.

773 With Alkaline earth metal compound, clay, or hydrosetting agent:

This subclass is indented under subclass 770. Process wherein an Alkaline earth metal compound, clay, or hydrosetting agent (e.g., cement, etc.) is incorporated in or coated on the consolidated material.

CROSS-REFERENCE ART COLLECTIONS

950 CONSOLIDATED METAL POWDER COMPOSITIONS OF 95% THEORETICAL DENSITY (E.G., WROUGHT, ETC.):

This and the indented subclass(es) are collections of published disclosures pertaining to consolidated metal powder compositions having such a small amount of enclosed voids that they approach, in their properties, the properties of compositions made by more conventional alloying or fusion techniques. These collections should not be considered complete.

- (1) Note. Except for patents classified in subclass 248, subject matter cross-referenced to this subclass should be considered a candidate for cross-referencing to subclasses 122.1+.

SEE OR SEARCH CLASS:

- 148, Metal Treatment, subclasses 11.5+ for processes which combine working and heat treatment of solid metal.

951 Oxide containing (e.g., dispersion strengthened, etc.):

This subclass is indented under subclass 950. Disclosures in which the composition contains a compound of oxygen.

SEE OR SEARCH CLASS:

- 148, Metal Treatment, subclasses 400+ for metals or alloys strengthened by the dispersion of oxides which have been prepared by melting (fusion) techniques.
428, Stock Material or Miscellaneous Articles, subclasses 639+ for a metallic composite in which a metal component contains oxygen.

952 PRODUCING FIBERS, FILAMENTS, OR WHISKERS:

This subclass is indented under the class definition. Art collection of patents drawn to producing powders or particles that are referred to as being “fibers”, “filaments”, or “whiskers.”

SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, especially subclasses 75, 87, 205, and 921, for processes and non-coating apparatus

for growing therein-defined single-crystal of all types of materials, including metals, which are in the form of whiskers.

953 PRODUCING SPHERES:

This subclass is indented under the class definition. Art collection of patents drawn to producing powders or particles that are referred to as being “spheres.”

954 PRODUCING FLAKES OR CRYSTALS:

This subclass is indented under the class definition. Art collection of patents drawn to producing powders or particles that are referred to as being “flakes” or “crystals”.

SEE OR SEARCH CLASS:

- 117, Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus Therefor, especially subclasses 75, 87, 205, and 921, for processes and non-coating apparatus for growing therein-defined single-crystal of all types of materials, including metals, which are in the form of whiskers.

955 PRODUCING DENTAL PRODUCT:

This subclass is indented under the class definition. Art collection of patents drawn to producing powders or particles that are useful as a dental product.

956 PRODUCING PARTICLES CONTAINING A DISPERSED PHASE:

This subclass is indented under the class definition. Art collection of patents drawn to producing powders or particles that contain a dispersion.

957 CONTINUOUS REFINING OF MOLTEN IRON (FE):

This subclass is indented under the class definition. Art collection of processes in which molten Iron (Fe) is treated to improve its properties by a process in which untreated molten Iron is added to an apparatus either continuously or intermittently and treated molten Iron is correspondingly removed from the apparatus. The apparatus remains substantially full of molten Iron being treated at all times. The process can be carried out for an indefinite period as long as more untreated Iron is added.

- (1) Note. The use of the term “continuous” in a patent is prima facie evidence that a cross reference is proper in this subclass in the absence of a positive indication that the process is carried out in a discontinuous manner, as by emptying an apparatus of treated Iron and refilling it with Iron to be treated.
- 958 WITH CONCURRENT PRODUCTION OF IRON (FE) AND OTHER DESIRED NON-METALLIC PRODUCT (E.G., ENERGY, FERTILIZER, ETC.):**
Art collection of patents in which other products are intentionally produced along with Iron (Fe). Excluded are the normal by-products such as flue gas and slag. However, if the Iron (Fe) making process is intentionally modified so that the by-products have special utility a cross-reference is placed here. As an example, if slag is specifically made to be high in phosphorus so that it is a good fertilizer a copy of the patent should be placed here.
- 959 THERMIT-TYPE REACTION OF SOLID MATERIALS ONLY TO YIELD MOLTEN METAL:**
Art collection of patents in which a mixture of solid materials including a reducible metal compound and a solid reducing agent are reacted so that the heat of reaction is sufficient to yield the reduced metal in molten condition.
- (1) Note. A common example is the reaction of Iron oxide and Aluminum (Al) powder which proceeds with sufficient vigor to produce Iron in molten form.
- (2) Note. Excluded herefrom are patents which treat molten metal with compositions which have ingredients which interact exothermically. For such patents see the appropriate subclass above relating to the treatment of the particular molten metal involved.
- 960 IN ZERO GRAVITY ENVIRONMENT:**
Art collection of patents in which any step takes place in an environment free of significant gravity (e.g., in outer space).
- 961 TREATING FLUE DUST TO OBTAIN METAL (OTHER THAN BY CONSOLIDATION):**
This subclass is indented under the class definition. Art collection of patents drawn to obtaining metal from the flue dust that issues from metallurgical furnaces such as blast furnaces. Excluded are processes which merely consolidate the flue dust.
- 962 TREATING OR USING MILL SCALE:**
This subclass is indented under the class definition. Art collection drawn to patents which treat mill scale to obtain metal, or which use mill scale in metallurgical processes other than in the open hearth manufacture of steel.
- (1) Note. Mill scale is the oxide which results when hot metal is rolled or forged in the air. It is usually Iron oxide.
- END